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# ROENTGENOLOGICAL TYPES OF PULMONARY LESIONS IN PRIMARY COCCIDIOIDOMYCOSIS

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DIAGNOSTIC roentgen criteria cannot alone be depended upon in differentiating primary coccidioidomycosis from other diseases it may simulate. However, scrutiny of roentgen evidence provided by studies of 75 cases seen during a recent "epidemic" indicates that fairly characteristic types of pulmonary lesions exist. When such lesions are observed by the roentgenologist, an opportunity for stimulating the search for corroborative laboratory and clinical data is presented.

## HISTORICAL AND CLINICAL CONSIDERATIONS

For a review of the work leading up to and following the discovery of the primary stage of coccidioidal infection reference should be made to articles by Dickson and Gifford,[4] Smith[6,7] and Winn.[8] Pertinent facts are briefly summarized: The notable endemic areas for this disease are in California's central valleys and Arizona, and less prominently, New Mexico, Texas and Mexico. Caused by inhalation of dust-borne chlamydospores of the fungus in its vegetative stage, the disease characteristically produces acute or subacute symptomatology consisting of dry cough, chest pain, malaise, fever, weight loss and night sweats. Five to 20 per cent may develop erythema nodosum or multiforme. Gradual recovery is the rule, symptoms usually subsiding in two to six weeks, but resolution of the pulmonary lesions is often prolonged weeks after the patient is clinically well. In an extremely small percentage of cases the highly fatal chronic disseminated granuloma stage develops, apparently as endogenous "reinfection." Carter[1] has described these pulmonary and extrapulmonary lesions.

## SOURCE OF CLINICAL MATERIAL

The cases reported consist of 75 soldiers admitted to the Station Hospital, Camp San Luis Obispo, California, between July 1 and August 15, 1942. This group is the subject of a paper by Goldstein and Louie,[5] in which the clinical and laboratory aspects of primary coccidioidomycosis are described. As therein indicated, the "epidemic" was associated with army maneuvers during the favorable dry, dusty season, affecting chiefly susceptible California non-residents recently arrived in the endemic area. Symptoms, prominently respiratory, usually developed ten to fourteen days following exposure. Suspected cases were studied and grouped as "positive" when they presented all of the following criteria:

(1) Recent exposure to inhalation of spore-laden dust.
(2) No previous history of exposure in an endemic area.

(3) Incubation period within known upper and lower limits.
(4) Positive coccidioidin (intradermal) reaction.
(5) Positive complement fixation, or precipitin tests showing titers compatible with the stage and severity of disease present.

Additional diagnostic evidence presented by most cases, included: pulmonary lesions demonstrated by serial roentgenograms, delayed resolution of such lesions, accelerated sedimentation rates, low grade fever, and moderately prolonged convalescence. Where sputum cultures were made, results were uniformly positive. Erythema nodosum or multiforme developed in 20 per cent of cases. Roentgenological follow-up studies were continued until pulmonary lesions were resolved or quiescent.

Serological tests and a number of sputum cultures were made available through the interest of Dr. Charles E. Smith, Department of Public Health and Preventive Medicine, Stanford University School of Medicine, San Francisco, California.

## ROENTGENOLOGIC "TYPES"

Of the 75 proved cases of primary coccidioidal infection, 29, or 38.7 per cent, presented infiltrative fan-shaped densities extending from prominent hilar shadows. This "linear mottling," which may involve in varying degree any lobe or portion thereof, resembles bronchopneumonic inflammation with a minimum of consolidation (see Case I, Fig. 1). Resolution is always slow, ranging from fifteen to ninety days and averaging forty days. Thus, by serial roentgen examinations, the lesions are differentiated readily from those of ordinary bronchopneumonia.

Hilar densities without evidence of significant peripheral bronchial or parenchymal involvement constitute 18 cases, or 24 per cent of the group. In some instances circumscribed lymphadenopathic shadows are seen, particularly in the stage of early regression. Minimal lesions present only a loss of bronchovascular hilar detail and care must be exercised in order to avoid "over-interpretation" of technically deficient roentgenograms. The likelihood of —"missing"— parenchymal lesions not yet formed, or already resolved, should be borne in mind; in fact, considered seriously where unusual hilar shadows are encountered.

Peripheral lobular and sublobular exudates and infiltrates were found in 20 instances (26.6 per cent of cases). These fairly well circumscribed, rather homogeneous peripheral densities are practically always associated with abnormal hilar shadows but they lack the radiating peribronchial infiltrations seen in "bronchopneumonic" types. Involvement of lower lobes predominated slightly, and when upper lobes were affected the lesions of course resembled minimal "reinfection" tuberculosis. However, more rapid and complete resolution is a differentiating feature since this averaged thirty-seven days in our series, and since conspicuous fibrosis was rare.

Demonstrable cavitation occurred in 3 cases (4 per cent). One was no longer demonstrable in sixty days, and one healed in ninety-five days, coincident with clearing of associated minimal infiltration and hilar adenopathy. The other has persisted as a cyst-like excavation resembling those described by Winn,[8] and others.

Two cases (2.7 per cent) presented massive pleural effusion without evidence of parenchymal infiltration and these, having subsided slowly, showed considerable residual pleural thickening at ninety days. Significantly, both showed strongly positive complement fixation and precipitin tests, indicating possible dissemination of the infection, and in one case proof of dissemination was presented by the appearance of a granulomatous skin lesion from which the fungus was recovered. Of the first three preceding groups, 7 cases showed associated slight to moderate pleuritis, often regional and interlobar (see Case III,

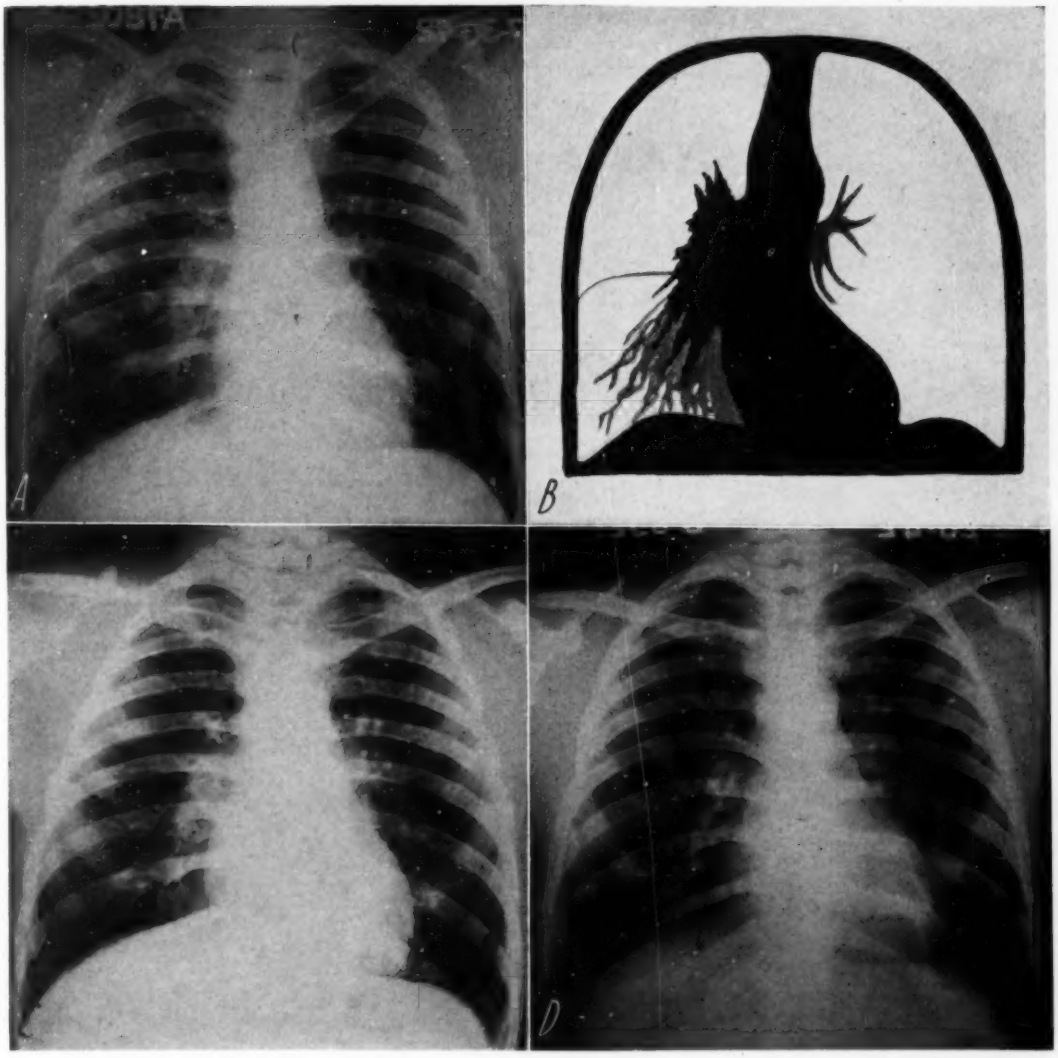


Fig. 1. Case 1. A. A. *Bronchopneumonic Type. A* and *B*, July 30, 1942. Roentgenogram and drawing showing enlarged, dense, confluent right hilar shadow, with linear and nodular mottling extending well into the right lower lung parenchyma. Minor fissure delineated. *C*, August 20, 1942. After three weeks considerable regression is evident, but infiltrates are still quite prominent and hilar shadow is accentuated. *D*, October 26, 1942. Accentuated bronchovascular markings remain, but shadows constituting the right hilum are more discrete.

Fig. 3). Clearing of such minimal pleural exudates was usually rapid and fairly complete.

Inconclusive roentgenographic evidence was considered to be present in only 3 cases (4 per cent) of this series. Obviously, only a portion of the primary infections resulting from the occasioned exposures are represented, since this group consists of soldiers whose respiratory and general symptoms were severe enough to interfere with performance of duty.

## THEORETICAL CONCEPTS OF PATHOGENESIS

Production of a variety of pulmonary lesions by *Oidium coccidioides* is well explained by the possible state of balance of three important factors: individual resist-

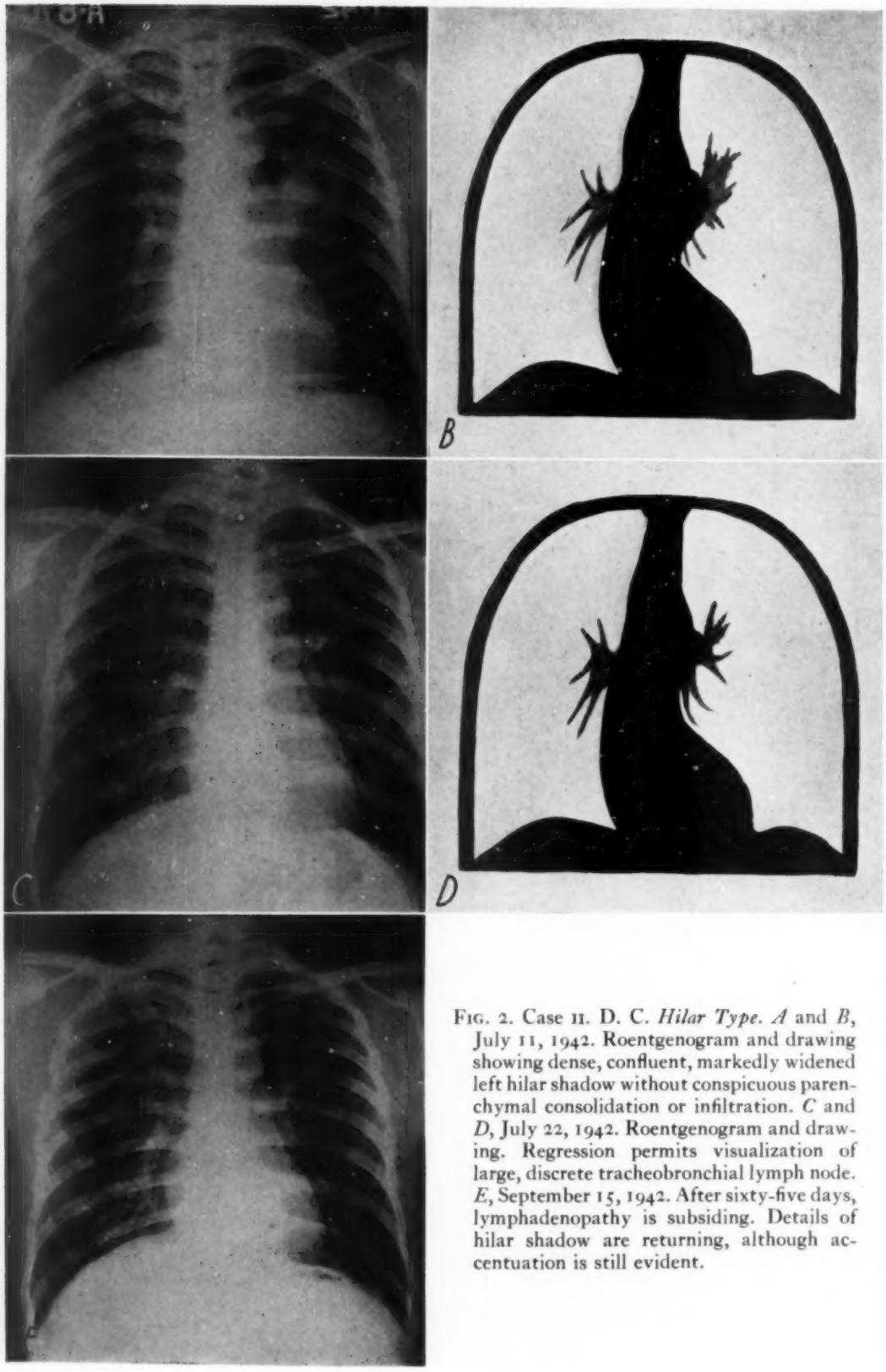


FIG. 2. Case 11. D. C. *Hilar Type. A* and *B*, July 11, 1942. Roentgenogram and drawing showing dense, confluent, markedly widened left hilar shadow without conspicuous parenchymal consolidation or infiltration. *C* and *D*, July 22, 1942. Roentgenogram and drawing. Regression permits visualization of large, discrete tracheobronchial lymph node. *E*, September 15, 1942. After sixty-five days, lymphadenopathy is subsiding. Details of hilar shadow are returning, although accentuation is still evident.

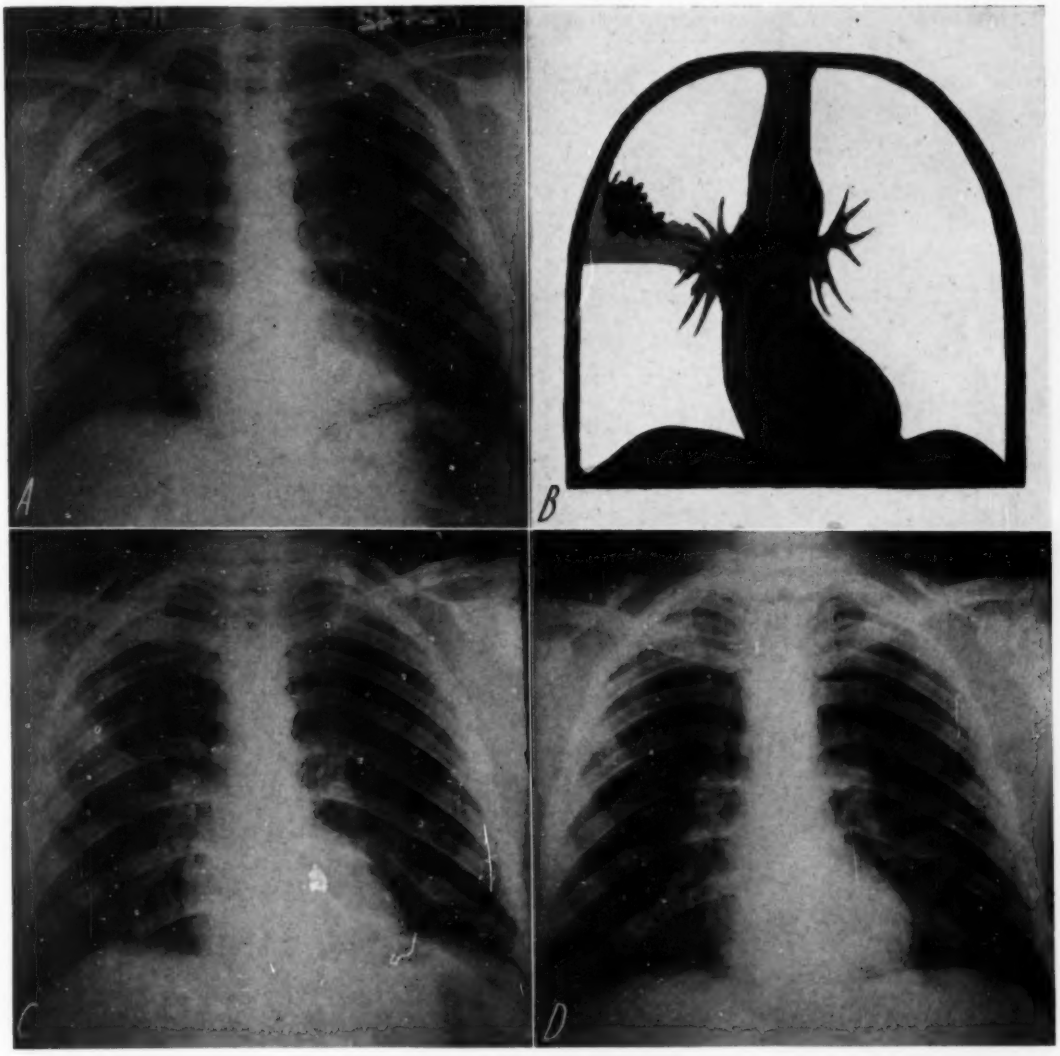


Fig. 3. Case III. O. R. *Peripheral Lobular Type. A* and *B*, July 24, 1942. Roentgenogram and drawing showing peripheral, circumscribed consolidation, right upper lobe, with associated regional localized effusion. Confluent hilar shadow. *C*, July 27, 1942. Rapid absorption of pleural exudate leaving lobular consolidation and moderately prominent right hilar shadow. *D*, August 19, 1942. Practically complete resolution of parenchymal consolidation. At twenty-six days only a few infiltrative strands and moderate hilar shadow prominence remain.

ance, dosage of the infecting organism, and allergic status of the host. A fourth factor may well be time, or the intervals of succeeding repeated infecting doses in relation to ascending allergy of pulmonary tissues. The interdependence of these factors would seem also to explain why manifestations of high allergy (coccidioidin positiveness and erythema nodosum) occur with variable time relations to the onset of symptoms (Smith[6]) and to the "onset" of exposure.

Application of these concepts to the lesions visualized is interesting, but not entirely satisfactory in the absence of further clinical and laboratory observations, such as bronchoscopy and serial coccidioidin, precipitin, complement fixation and sputum tests. However, such studies have not been available on a large case series. Pathological (autopsy) data are, for obvious reasons, lacking. The findings of Cronkite and Lack,[3] in experimental animals, can hardly be ap-

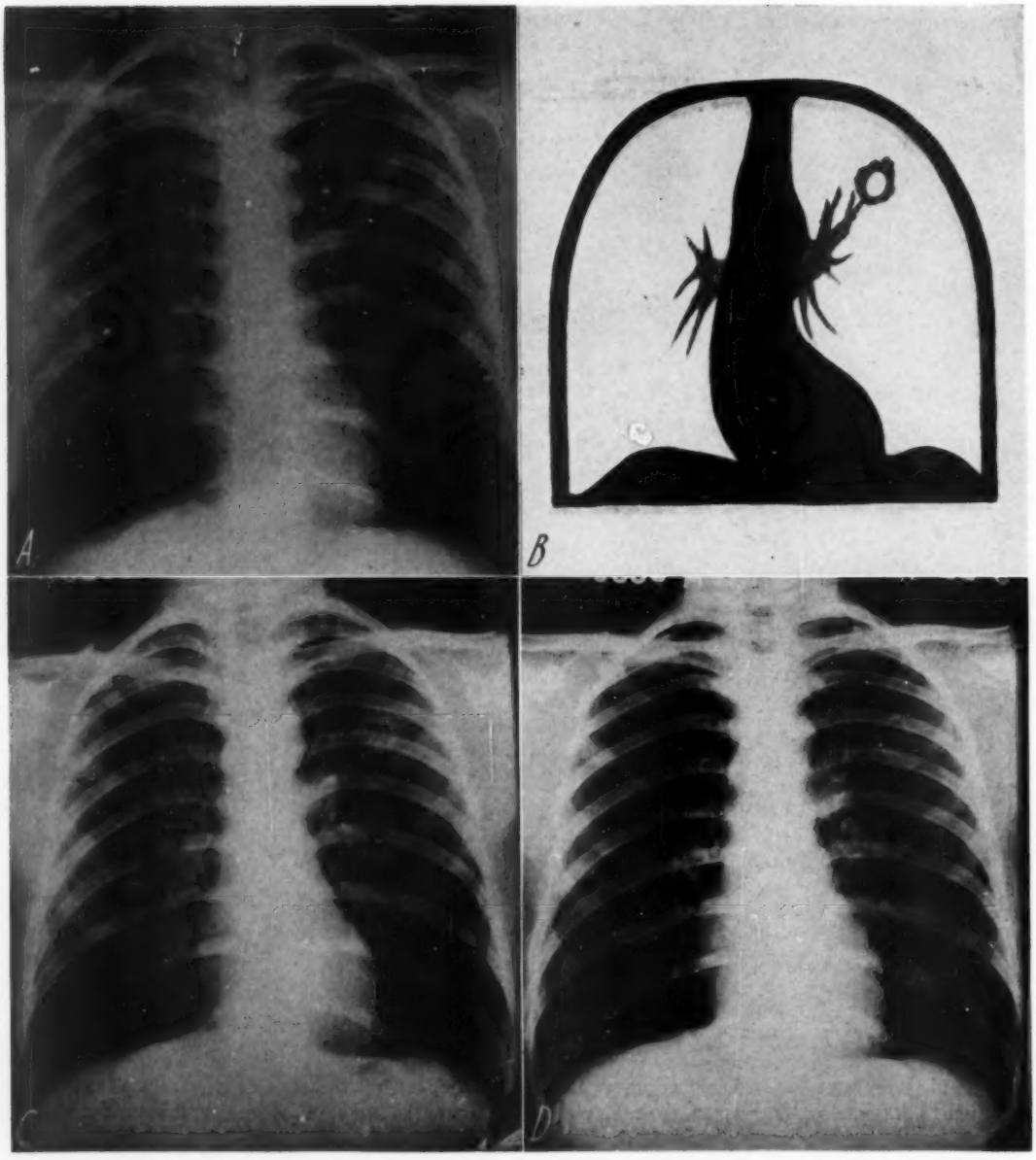


Fig. 4. Case iv. E. C. *A* and *B*, July 24, 1942. Roentgenogram and drawing showing cavitation in left upper lobe, with minimal surrounding inflammatory consolidation and infiltration. Hilar shadow only slightly prominent. *C*, September 7, 1942. Slight regression after thirty-five days. *D*, September 22, 1942. "Ballooning" of cyst-like cavity, due to ball-valve bronchial obstruction. Cavity was only slightly smaller at ninety-five days.

plied to humans in view of evident differences in infecting doses and time intervals and in view of the relatively low sensitivity of guinea pigs to coccidioidin.

Despite the lack of such direct evidence, an attempt has been made to visualize the anatomical changes responsible for roentgen appearances. Well defined criteria are discussed separately:

1. *Loss of Hilar Shadow Detail; Slight General Increase in Hilar Density.* Probably due to initial invasion of mucosa and submucosa of primary and secondary bronchi with subacute inflammatory changes in

these tissues as well as in mild degree in the subjacent lymphatic structures.

2. *Confluence of Hilar Shadows with a Fringe of Accentuated, Poorly Delineated Bronchovascular Markings; Tracheobronchial Lymphadenopathy.* Continuation of the invasion of lymphatic structures provides obvious dense and more homogeneous hilar shadows, occasionally to the point where circumscribed enlarged lymph nodes are visible with accompanying evidence of peribronchial inflammatory exudate and cellular proliferation.

3. *Fan-shaped Extensions into Any Lobe of the Lungs; Linear and Nodular "Mottling."* Extension of the process into the tertiary bronchi and bronchioles produces the roentgen picture of bronchopneumonia. Alveolar involvement is limited and largely interstitial, and the peribronchial reaction is predominantly proliferative and cellular.

4. *Lobular and Sublobular Exudates and Infiltrates.* Depending upon the predominance of one or more factors, pulmonary parenchymal tissues in a localized area, often a lobule, respond to produce a fairly characteristic peripheral density. It is usually circumscribed, solitary (occasionally multiple and widespread), and associated with evidence of some degree of the above described hilar pathology.

5. *Pleural Exudates.* As in tuberculosis, the extent of pleural effusion has no regular relationship to the size and location of visible parenchymal and hilar lesions. Mechanical disturbance of lymphatic flow and tissue allergy, no doubt, are as important factors as the nearness of subjacent parenchymal lesions.

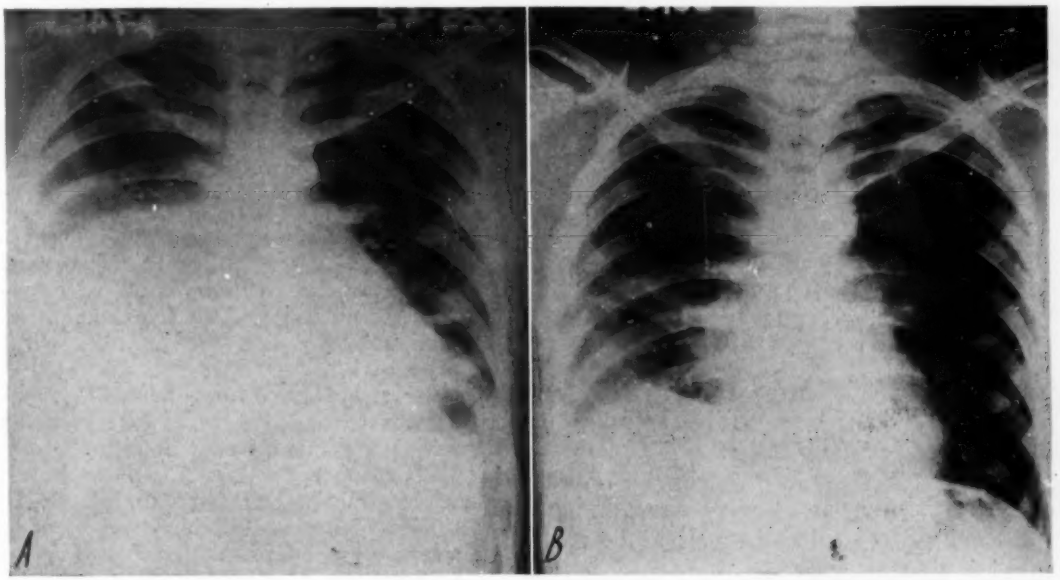


Fig. 5. Case v. S. C. *A*, July 26, 1942. Pleural effusion, right, with slight displacement of heart and mediastinum to the left. Parenchymal involvement, if any, obscured. *B*, October 12, 1942. Residual pleural thickening and right lower hilar prominence. Right diaphragm elevated and heart retracted to right. Patient developed metastatic granulomatous skin lesions.

6. *Excavation of Pulmonary Tissues.* Small, cyst-like cavities with thin walls and little surrounding tissue reaction may persist long after infiltrates have cleared and after serological studies show that the infection is well focalized. A bronchial factor was indicated in one of our cases by intermittent "ballooning" of a thin-walled cavity, and by its failure to fill when lipiodol was instilled into the area.

7. *Retarded Resolution of Pulmonary Le-*

*sions.* Indications of a predominantly proliferative reaction with a minimum of fibrosis are found in the characteristic course of the disease. Areas of exudation clear fairly rapidly (ten to twenty days) but infiltrates require thirty to ninety days and occasionally longer. Permanent fibrotic residues are not conspicuous.

8. *Calcification of Healed Lesions.* This has been observed by Cox and Smith[2] and is evidence of caseation of tracheobronchial lymph nodes during primary infection, with subsequent healing.

## SUMMARY

The primary stage of coccidioidal infection is an acute or subacute respiratory infection varying greatly in severity of clinical manifestations, usually in accord with the extent of pulmonary lesions. However, because the initial lesion is evidently a low grade bronchitis, roentgenological findings are often inconclusive. In instances where sufficient numbers of coccidioides spherules attain the submucosa and lymphatics of the bronchi, their effects may be visualized roentgenologically. This was found to be true in 96 per cent of 75 cases hospitalized because of primary infections. Progressive involvement of distal bronchial and peribronchial tissues may produce roentgen shadows identical with those found in bronchopneumonia, or in tuberculosis when upper lobes are involved. Nearly as often, circumscribed lobular and sublobular exudates and infiltrates with associated dense hilar shadows appear. Regional and massive pleural exudates are fairly common, and cavitation may occur and persist despite apparent clinical recovery. The most constant finding is hilar shadow confluency, widening and increased radiopacity. The most valuable diagnostic roentgen criterion is delayed but fairly complete resolution, placing the disease midway between "acute" and "chronic" in the scale of pulmonary inflammations.

## CONCLUSION

Roentgenological evidence in 75 cases of primary coccidioidomycosis is classified with the idea of establishing diagnostic criteria. Common types of pulmonary lesions are described and possible pathogenesis suggested. The importance of hilar shadow changes and of observations during resolution are emphasized.

Photographic reproductions by T/3 Louis C. Roberts, Assistant Chief Technician, X-Ray Service, Station Hospital, Camp San Luis Obispo, California.

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# ACUTE PHOSGENE POISONING

## ROENTGEN FINDINGS IN THE LUNGS: CASE REPORT

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ALTHOUGH lung changes in acute phosgene poisoning are undoubtedly quite common, published roentgenograms of this condition are very few.[1] The following case report demonstrates these changes and is, as well, of general interest at this time.

### CASE REPORT

M. B., aged twenty-eight, a member of the Chemical Warfare Service, was, on the afternoon of May 20, 1943, decompressing a "sniff-set" containing phosgene. (A "sniff-set" is a small bottle of gas used for training purposes by the Chemical Warfare Service.) He was exposed to the gas for several seconds. The only immediate effect was momentary coughing. This was followed by headache and slight nausea, progressive in nature, until midnight, when coughing became more severe. Weakness, nausea and vomiting and tickling sensation in the chest became more marked at this time. He was admitted to the Station Hospital, New Orleans Port of Embarkation, New Orleans, Louisiana, at noon, May 21, 1943, twenty-two hours after exposure to the gas.

Physical examination on admission showed an acutely ill and apprehensive white male with distended neck veins and considerable cyanosis of the nail-beds and lips. Pulse was 132, respirations 42 per minute, temperature 100.5°F., blood pressure 120/82. The white blood count was 12,650, 73 per cent segmental forms, 24 per cent lymphocytes. Red blood cell count was 4.5 million. Examination of the chest showed numerous large moist râles on both sides, indicative of a "wet" lung.

The patient was placed in an oxygen tent; sedation was given and 50 per cent glucose intravenously. Improvement was very slow for the first few days. Sulfadiazine, grams 1 q 6 h, to a total of 15 grams, was administered in order to prevent secondary bronchopneumonia. The generalized râles disappeared gradually. By the fourth day they were localized to the left base. They were gone by the tenth day. The general condition of the patient ran parallel to the lung findings. Oxygen was discontinued by stages, beginning on the fourth day.

Roentgen examination immediately on admission (Fig. 1) showed a diffuse, soft, bilateral mottled infiltration, interpreted as edema of the lungs, due to irritant gas. (Figures 1, 2 and 3 were taken with portable, supine technique.)

FIG. 1. Roentgenogram taken twenty-two hours after exposure to gas shows a diffuse, soft, mottled infiltration and thickening of the lung markings bilaterally, interpreted as pulmonary edema due to irritant gas.

Forty-eight hours later (Fig. 2) this had decreased slightly in extent except at the left base. Seventy-two hours after admission (Fig. 3) the process was shown to be localized mainly at the left base. There was still a slight generalized infiltration. Six days after admission (Fig. 4) there was still a slight residual infiltration at the left base and thickening of the root markings in this area.

Lipiodol study (Fig. 5) done on July 1, 1943, showed no change in the visualized bronchial tree.

FIG. 2. Roentgenogram taken seventy hours after exposure to gas shows slight decrease in the extent and severity of the process.

FIG. 3. Roentgenogram taken ninety-four hours after exposure to gas shows the localization of the process at the left base.

COMMENT

The outstanding pathological feature in the lungs in acute phosgene poisoning is pulmonary edema.[2] This is often the most serious clinical aspect of the condition. Serial roentgenograms, as demonstrated in

FIG. 4. Roentgenogram taken seven days after exposure to gas shows residual infiltration at the left base and thickening of the lung markings in this area.

FIG. 5. Roentgenogram taken six weeks after exposure to gas, with lipiodol instillation, shows no demonstrable abnormality of the visualized bronchial tree.

this case, show the extent and severity of the process and the results of treatment.

Other gases, such as chlorine, diphosgene, nitric oxide and chloropicrin are lung irritants and may produce similar changes.[3,4] Different physical properties of some gases, however, result in differences in the nature and distribution of the pathology in the respiratory tract.[3,4]

Residual damage to the lungs is said to occur in some cases of phosgene poisoning.[2] Roentgenologically, this case showed complete clearing of the acute process. The patient's only complaint at last examination was an afternoon cough. However, secondary changes may be demonstrable at a later date.

Lipiodol study showed no change in the visualized bronchial tree at six weeks. This study was not done sooner because the added insult to the lungs at such a time might have done considerable damage. Later study with lipiodol is indicated.

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# CHOLECYSTOGRAPHY AND JAUNDICE

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REVIEW of the literature reveals a surprising divergence of opinion as to the safety and value of cholecystography in patients with jaundice.

Ottenberg and Abramson[15] in 1925 warned that the administration of gallbladder dye might be dangerous in the presence of liver disease.

In the same year Lange[10] reported that uniformly a gallbladder will fail to visualize in the presence of jaundice irrespective of whether the jaundice is obstructive or infectious. No untoward effect due to the administration of dye in jaundice was noted.

In 1926 Fried and Whitaker[7] showed that even after damage of dogs' liver by chloroform anesthesia, the drug could be used in amounts equivalent to four times the human dose. With extreme liver damage no shadow was obtained.

Graham, Cole, Copher and Moore[8] in 1928 believed that patients having acute liver infection or common duct obstruction should not be submitted promiscuously to cholecystography, although actually injected cases showed no greater percentage of reaction. They also stated that they had found that the gallbladder can usually be visualized in cases of jaundice, irrespective of its cause. Their practice was to omit cholecystography as it may be wholly deceptive.

Rudisill,[16] in 1930, reported the results of examination of 10 patients with jaundice by the intravenous injection of 3.5 grams of sodium tetraiodophenolphthalein. He noted no unusual reaction and advised intravenous cholecystography as a possible means of helping to differentiate causes of jaundice. In 7 of 8 cases of infectious jaundice he obtained successful visualization. One of the other 2 cases was deeply jaundiced due to a common duct stone; nevertheless, a gallbladder full of stones was visualized. In the last case no shadow was seen. Autopsy showed cancer of the common duct.

Walsh and Ivy,[18] in 1931, reported the results of two experiments: (1) Common duct obstruction was produced in dogs after intravenous visualization of the gallbladder. In spite of daily fatty meals the shadow persisted for at least two weeks. (2) After production of common duct obstruction in dogs, retarded and faint gallbladder visualization was obtained after intravenous injection of tetraiodophenolphthalein. The toxicity of the drug was apparently not increased by the jaundice.

Also in this year Nord[13] demonstrated that it was often impossible to obtain a normal cholecystogram in the presence of acute hepatitis, particularly when the degree of icterus was increasing. There appeared to be a parallelism between the ability of the liver to excrete bile and dye.

Blomström and Sandström,[2] in 1932, showed that bromsulfalein retention of over 40 per cent indicated sufficient liver damage to prevent gallbladder visualization.

Foley,[5] in 1933, reported 29 cases, all but one by the oral method. No untoward reactions were noted. He concluded that visualization of the gallbladder in the presence of jaundice means an intrahepatic cause for jaundice, while no shadow is of no diagnostic significance. Of this series, 16 cases were medical and in 11 of these the gallbladder was visualized. The other 13 cases were surgical (i.e., common duct obstruction due either to stone or cancer) and none of these was visualized.

Also in 1933 Ferguson and Palmer[4] in a series of 1,398 cases of good visualization found among them: 1 case of atrophic cirrhosis; 8 cases of catarrhal jaundice; and 3 cases of neoplasm of the liver.

McWhirter,[11] in 1935, stated that chole-

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TABLE I

SUMMARY OF 50 UNSELECTED CASES OF JAUNDICE EXAMINED BY CHOLECYSTOGRAPHY

| Patient | Age | Sex | Diagnosis | Degree of Jaundice | Cholecystographic Findings |
|---|---|---|---|---|---|
| | | | INCREASING JAUNDICE | | |
| L. W. | 48 | F | Probable cholelithiasis with common duct obstruction | 3/15/35— 10; subsequent clinical increase | No shadow (3/21/35) |
| E. C. | 55 | F | Common duct stone; operated 8/19/38 | 8/15/38— 13.2; subsequent clinical increase | No shadow (8/13/38) |
| W. S. | 46 | M | Probable common duct stone | 1/ 3/37— 10.5<br>1/12/37— 40<br>1/19/37— 30.5 | No shadow; 4 day examination (1/17/37) |
| H. F. | 58 | M | Diagnosis cancer of pancreas; operated 5/2/35 | 4/25/35— 32<br>5/ 1/35— 50 | Faint shadow; some emptying (4/22/35) |
| H. K. | 59 | F | Common duct stone; operated 11/9/38 | 10/27/38— 51<br>11/ 1/38— 72<br>11/ 7/38— 50 | No shadow (10/29/38) |
| S. W. | 62 | M | Primary cancer of liver; no common duct obstruction; autopsy 7/27/38 | 7/12/38— 13<br>7/19/38— 36<br>7/26/38— 50 | Fairly dense shadow with emptying (7/14/38) |
| K. K. | 38 | F | Chronic cholecystitis and hepatitis; no stones; operated 3/5/36 | 12/30/35—250<br>1/ 4/36—125<br>1/18/36— 80<br>2/15/36—115 | Faint shadow; some emptying (2/1/36) |
| M. F. | 61 | F | Atrophic cirrhosis of liver at autopsy 7/12/35 | 7/ 2/35—142; subsequent clinical increase | No shadow (7/7/35) |
| F. K. | 58 | M | Cancer of common duct; operation 3/16/39 (cholecystitis and cholelithiasis) | 3/ 7/39—115<br>3/17/39—158 | No shadow (3/16/39) |
| H. G. | 75 | M | Cancer of liver; operation 2/11/39 | 1/31/39— 55<br>2/ 5/39—101 | No shadow (2/3/39) |
| W. H. | 52 | M | Duodenal ulcer at roentgen examination | 10/20/39— 20<br>10/23/39— 10<br>10/30/39— 20 | No shadow (10/26/39) |
| J. N. | 71 | M | ? Gained 15 lb. after discharge from hospital; still alive 4/1/39 | 11/11/38— 59<br>11/18/38— 56<br>11/26/38— 78 | No shadow (11/21/38) |
| M. K. | 67 | F | Cancer of common bile duct; operation 7/19/39 | 6/30/39— 66<br>7/13/39— 82<br>7/29/39—120 | No shadow (7/3/39) |
| B. B. | 47 | F | Cancer of pancreas; operated ated 2/18/35 | Deeply jaundiced; increasing clinically | No shadow (3/15/35) |
| | | | DECREASING JAUNDICE | | |
| G. M. | 40 | F | Clinically spontaneous passage of common duct stone | 8/ 1/36—100<br>10/ 2/36— 41<br>10/23/36— 26 | No shadow (10/1/36), (10/24/36) |
| P. L. | 68 | M | Catarrhal or toxic jaundice; alive and well 5/19/40 | 10/10/38—200<br>10/20/38—166 | Very small faint shadow with emptying (10/13/38) |

TABLE I—*Continued*

| Patient | Age | Sex | Diagnosis | Degree of Jaundice | Cholecystographic Findings |
|---|---|---|---|---|---|
| | | | DECREASING JAUNDICE | | |
| W. B. | 57 | M | Clinically acute toxic hepatitis; alive and well 1/30/40 | 9/21/38—250<br>10/24/38— 52 | Small faint shadow (9/27/38) |
| S. C. | 7 | M | Diagnosis clinically catarrhal jaundice; later generalized lymphadenopathy without jaundice | 4/27/38— 80<br>5/10/38— 20 | Good shadow with emptying (5/14/38) |
| G. F. | 11 | M | Clinically catarrhal jaundice | 5/17/38— 40<br>5/28/38— 8 | Fairly dense shadow (5/26/38) |
| H. S. | 11 | F | Clinically catarrhal jaundice | 4/ 2/38— 45.5<br>5/11/38— 23 | Good shadow (5/14/38) |
| K. C. | 34 | M | Clinically catarrhal jaundice; alive and well 4/25/37 | 5/ 7/36—227<br>5/27/36— 29<br>6/ 2/36— 22 | Good shadow (6/1/36) |
| A. D. | 42 | F | Clinically catarrhal jaundice; alive and well 11/10/35 | 2/15/35—250<br>3/ 2/35— 58 | Good shadow (3/8/35) |
| M. G. | 42 | F | Clinically infectious jaundice; died; no autopsy | 9/28/36— 80<br>10/16/36— 50 | No shadow (10/10/36) |
| H. H. | 47 | M | Clinically catarrhal jaundice; alive and well 11/21/37 | 10/10/36—172<br>10/17/36—153<br>10/29/36— 77<br>11/23/36— 20 | Faint shadow; some emptying (10/22/36) |
| P. G. | 65 | M | Clinically spontaneous passage of common duct stone | 10/ 6/38— 27<br>10/14/38— 11 | No shadow (10/10/38) |
| B. A. | 52 | F | Cholelithiasis and cholecystitis; operated 7/12/37 | 6/16/37— 57<br>6/21/37— 24<br>7/ 1/37— 17 | No shadow (6/25/37) |
| A. B. | 73 | F | Probable inflammatory lesion of head of pancreas and liver; gallbladder negative; peritoneoscopy 11/1/38; died 2/2/39; no autopsy | 10/10/38— 50<br>10/21/38— 33 | No shadow (10/17/38) |
| A. K. | 65 | F | Common duct stone; operated 12/16/37 | 12/ 6/37—100<br>12/14/37— 66.5 | No shadow (12/8/37) |
| J. B. | 67 | M | Cancer common duct; operated 10/28/39; (cholecystogastrostomy) (cholelithiasis); autopsy 11/2/39 | 10/19/39—165<br>10/26/39—156 | Faint shadow with opaque stones (10/26/39) |
| E. G. | 47 | F | Clinically spontaneous passage of common duct stone | 2/15/38— 10; subsequent decrease | Faint large shadow; several small stones (2/17/38) |
| J. T. | 59 | F | Clinically chronic cholecystitis and hepatitis; acute cholangitis. | 6/ 1/35— 31<br>6/ 5/35— 16<br>6/15/35— 12 | Very faint shadow (6/15/35) |
| R. W. | 64 | F | Cholelithiasis; operated 7/28/38 | 7/13/38— 42<br>7/18/38— 14.5<br>7/23/38— 14 | Faint shadow with stones; no emptying (7/26/38) |
| A. W. | 23 | F | Cholelithiasis, cholecystitis | 11/12/34— 20<br>11/23/34— 7 | Very faint shadow with probable stones (11/19/34) |
| M. McC. | 42 | F | Cholecystitis, cholelithiasis; operated 5/3/34 | 4/24/34— 15; subsequent decrease | No shadow (4/26/34) |

TABLE I—*Continued*

| Patient | Age | Sex | Diagnosis | Degree of Jaundice | Cholecystographic Findings |
|---|---|---|---|---|---|
| | | | DECREASING JAUNDICE | | |
| J. H. | 71 | M | Cholelithiasis, common duct stone | 7/31/39— 20<br>8/ 4/39— 18<br>8/10/39— 11 | No shadow (8/4/39) (gallstones in gallbladder and duct system) |
| O. Z. | 46 | M | Probable cirrhosis of liver; died 8/1/39; no autopsy | 4/ 8/38—200<br>4/14/39—176<br>5/ 3/39—165 | No shadow (4/13/39) |
| G. F. | 45 | M | Common duct stone; removed at operation 6/28/39 | 5/17/39— 50<br>5/25/39— 37.5<br>6/10/39— 20 | No shadow (5/22/39); (choledochogram showed common duct stone) (6/27/39) |
| H. F. | 62 | M | Acute and chronic cholecystitis; no stones at operation 6/7/39 | 5/20/39— 44<br>6/ 1/39— 11 | Very faint shadow (6/3/39) |
| F. E. | 30 | M | Clinically catarrhal jaundice | 9/ 1/34— 75<br>9/12/34— 24 | Good shadow (9/19/34) |
| R. S. | 59 | M | Autopsy 6/20/39; cancer head of pancreas with generalized carcinomatosis | 8/13/37—143<br>8/17/37—154<br>9/21/37— 22<br>1/15/38—100<br>6/ 3/38— 80 | No shadow (8/5/37) |
| E. J. | 37 | F | Probable spontaneous passage of common duct stone | 4/12/40— 80<br>4/22/40— 26.6<br>4/29/40— 20 | Faint shadow with nonopaque stones (4/25/40) |
| J. P. | 31 | M | Common duct stone; operation 12/15/38 | 12/ 3/38— 20<br>12/17/38— 6.6 | No shadow (12/1/38 and 12/13/38) |
| V. D. | 19 | F | Cholelithiasis; operated ated 4/22/39 | 3/17/39— 22<br>3/27/39— 8 | No shadow (3/23/39); calcified stones |
| E. D. | 45 | F | Cholecystitis; no stones; opated 2/11/39 | 2/ 7/39— 25<br>2/ 9/39— 18 | No shadow (2/8/39) |
| M. S. | 49 | F | Probable common duct stone; refused operation | 2/14/39—100<br>2/24/39— 96<br>3/20/39— 55<br>3/27/39— 33 | No shadow (2/20/39) |
| M. H. | 66 | F | Cholecystostomy in 1933 for cholelithiasis; common duct stone; removed at operation 3/2/40; cholecystectomy 6/27/40; no complaints | 2/ 3/40— 22.5<br>2/23/40— 10<br>4/23/40— 12<br>5/ 2/40— 9 | No shadow (2/5/40) (cholangiogram 3/26/40 showed common duct stone) |
| J. C. | 6 | M | Hepatitis due to sulfapyridine; alive and well 6/4/40 | 3/22/39— 66<br>4/ 1/39— 40<br>4/20/39— 20 | Good shadow (4/13/39) |
| J. C. | 54 | F | Common duct stone; cholecystectomy and removal of common duct stone 6/19/39 | 5/21/39— 80<br>5/29/39— 62.5<br>6/10/39— 24 | No shadow (5/27/39) |
| J. McM. | 72 | M | ? Died 9/5/39 (no autopsy) | 3/ 8/39— 45<br>3/10/39— 30<br>3/17/39— 37.5<br>3/28/39— 20 | No shadow (3/17/39) |
| W. S. | 56 | M | ? Died several months later | 8/23/39—151<br>8/30/39—134<br>9/ 8/39—131<br>9/19/39—195 | No shadow (8/25/39) |

cystography should not be used in patients suffering from obstructive jaundice because fatal pancreatitis can sometimes follow such cases. In one of his own patients with slight jaundice a good shadow was obtained; the patient died ten days later from subacute yellow atrophy.

Foote and Carr,[6] in 1936, reported giving gallbladder dye (iodeikon) intravenously in fractionated dosage to 17 patients with jaundice without ill effect. As a result of this work and similar studies on dogs in which complete common duct obstruction had been produced, they stated that common duct (extrahepatic biliary) obstruction is demonstrated by the retention of the dye for forty-eight hours or longer in the extrahepatic biliary system. With intrahepatic obstruction the biliary system is not visualized after forty-eight hours, although a normal gallbladder shadow may be seen at twenty hours. They believe that we have here an aid in differentiating intrahepatic from extrahepatic biliary obstruction.

Jacobi,[9] in 1937, stated that visualization of the gallbladder in the presence of jaundice was obtained only in cases of toxic jaundice and agreed with Foley in the opinion that the absence of a shadow is of no value at all, but the presence of one confirms the existence of a non-obstructive jaundice. Visualization of the gallbladder with the oral administration of the dye was successful in 7 out of 8 of these cases in which it was attempted. The highest icterus index at which such visualization occurred was 66.

In 1937 Ottenberg,[14] changing his original position, stated that one is justified in attempting gallbladder visualization either by the oral or intravenous route in the presence of jaundice. His diagnostic criteria after this procedure are the same as those of Foote and Carr; namely, successful visualization followed by normal emptying points to hepatitis as the cause of jaundice; successful filling with failure to empty after the fatty meal points to obstructive jaundice; failure of visualization is of no differential or diagnostic aid. He still feels that there should be some selection of the cases in which cholecystography is attempted. Various tests are enumerated which are available as indices of the degree of liver damage. No cases are reported.

Behrens,[1] in 1940, stated that a gallbladder series is not often of much value in jaundice because, with the usual nonvisualization, one cannot differentiate between an obstructive pathological condition or parenchymatous failure to excrete. With visualization and good emptying, obstruction is, of course, ruled out.

Buckstein,[3] in 1940, stated that his personal experience shows the procedure to be essentially innocuous and also may be of considerable aid in differential diagnosis. In jaundice he employs the following criteria: If a gallbladder fills and empties, jaundice is due to hepatitis; if there is a good shadow without emptying, the jaundice is of obstructive nature. No mention is made of the significance of no shadow. One case is reported in which the relatively faint shadow of an enlarged gallbladder was obtained in a patient with jaundice. There was no decrease in the size of the shadow after a fatty meal. Autopsy showed cancer of the pancreas with common duct obstruction.

In the past five years 50 unselected cases of jaundice have been submitted to cholecystography by the intensified oral method of Stewart and Illick.[17] There were no intravenous injections. No deleterious effects due to the procedure were noted.

Practically all of the cases had one or more determinations of the icterus index,[12] which is a quantitative estimation of the amount of bile pigment in the blood stream.

The largest group (15 cases) was that of common duct stone. Eleven showed "no shadow" of the gallbladder (opaque calculi were seen in two of the preliminary roentgenograms); faint gallbladder shadows were seen in the 4 remaining cases.

There were 3 cases of cholecystitis without cholelithiasis of which 2 had faint shadows; the other one no shadow.

The second largest group (11 cases) had no final diagnosis. A very faint shadow was obtained in only 1 case. The other 10 cases had no shadow.

The only other large group (10 cases) was that of toxic and infectious hepatitis (including so-called "catarrhal jaundice"). Good shadows were obtained in 7, faint shadows in 3 cases.

In the smaller groups, such as cancer of the pancreas (3 cases) a faint shadow appeared in 1, no shadow in the other 2 cases.

Similar findings occurred in the 3 cases of cancer of the common duct. Two cases of cancer of the liver were encountered, 1 case with and the other without a gallbladder shadow. No visualization of the gallbladder occurred in 1 case of cirrhosis of the liver and 1 case of duodenal ulcer associated with jaundice.

From a practical point of view the entire situation resolves itself into an attempt to distinguish between surgical and medical cases of jaundice. This was possible to a large extent in those 36 cases in which jaundice was decreasing. Since a patent common duct is here predicated, the same diagnostic criteria are used as in patients without jaundice. With increasing jaundice, however (the remaining 14 cases), diagnostic information is usually not obtained since apparently no difference exists in the degree of impairment of dye excretion whether due to back pressure (extrahepatic biliary obstruction) or to parenchymatous disease, either toxic, infectious, cirrhotic or neoplastic.

## CONCLUSIONS

Cholecystography in jaundice, while apparently not harmful, is of little or no differential value when jaundice is increasing and when jaundice is decreasing may well be deferred.

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# LAMINAGRAPHIC STUDIES OF THE AORTA*

## THEIR ADVANTAGES AND LIMITATIONS

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ROENTGENOGRAPHIC examination of the thoracic aorta by the routine methods is all too frequently unsatisfactory. The difficulty lies largely in the fact that the aorta is in intimate contact with structures of similar density. Adequate visualization is further hampered by the overlying and obscuring shadows of the lungs and ribs. Three roentgenographic procedures are available for use in partially overcoming these difficulties. The first of these is the use of stereoscopic roentgenography in various positions. This spreads out the thoracic contents into a third dimension, but it does not eliminate the overlying shadows or provide a greater contrast in the density of the aorta over that of its neighboring structures. Since we are discussing roentgenographic methods, it is hardly necessary to mention here that roentgenoscopy is a very important part of every examination of the aorta.

The second procedure is the injection of a contrast medium into the blood stream and roentgenographing the aorta at the moment the contrast medium is in it. Without going into the details of cardiovascular opacification it requires experience and special equipment, and even then satisfactory visualization is not always obtained. The third method, and the one employed in this study, is body section roentgenography. The advantages of sectional roentgenography are: (1) it is a simple roentgenographic procedure that can be carried out by a technician; (2) the intravenous injection of a contrast medium is avoided; (3) the examination is not uncomfortable or hazardous for the patient, and (4) the shadows of overlying and obscuring structures are eliminated. Thus, on sectional roentgenograms, the aorta is seen with greater clarity and the observer's attention becomes automatically focused on it and the structures which lie in the same plane.

These advantages should not be inferred to mean that sectional roentgenography is superior to cardiovascular opacification. The latter is a feasible and excellent method of visualizing the aorta, and when successful, gives the most complete record of the aorta. Many times, however, the aorta can be sufficiently well demonstrated on the sectional roentgenograms without necessitating opacification of the vessel. It is for this reason that we are presenting these studies.

The laminagraph of Kieffer and Moore was used for all the sectional roentgenograms. It is well suited for the examination because by employing the spiral movement all the unwanted shadows are blurred out. This produces a sectional roentgenogram with a homogeneous black background undisturbed by incompletely "blurred out," distorted shadows of unwanted objects. It is this feature, in our opinion, that makes the laminagraph superior to other equipment for sectional roentgenography. The principles of sectional roentgenography[1,2,5] are now generally understood and will not be referred to at this time.

### TECHNIQUE

The technical factors employed are the same as those used in previous studies of

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† The opinions or assertions contained herein are the private ones of the writer and are not to be construed as official or reflecting the views of the Navy Department or the Naval Service at large.

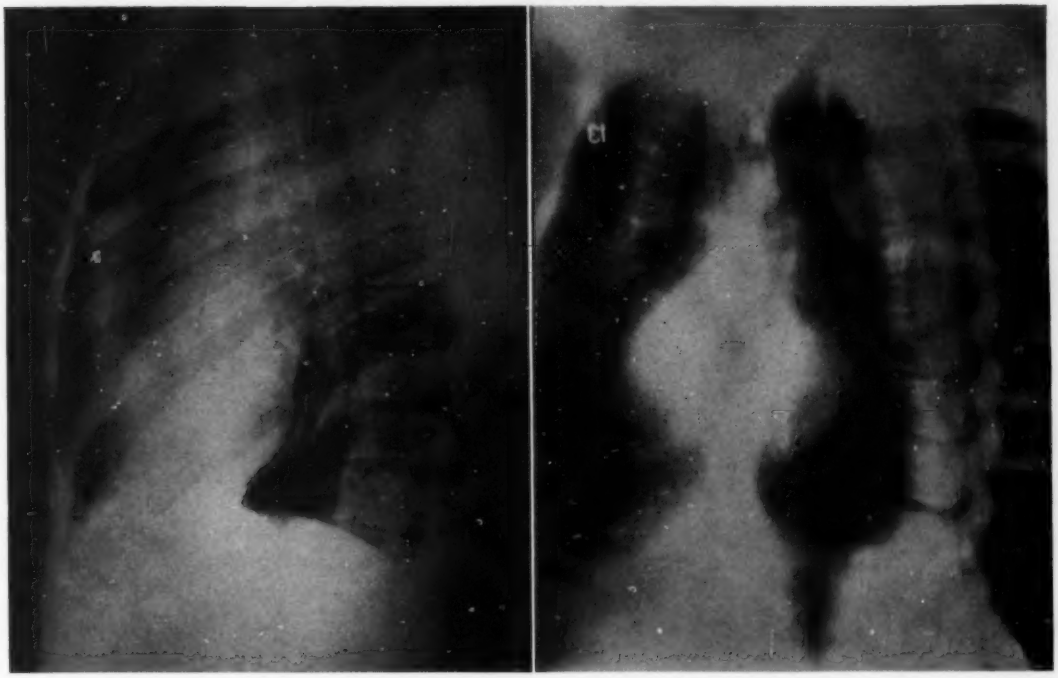

FIG. 1. Both routine and sectional roentgenographic examinations of the aorta in children and in young adults usually are not satisfactory. This is largely because the aorta is smaller in diameter, the walls are thinner, and the width of the aortic arch is narrower. *A*. On the conventional left anterior oblique chest roentgenogram of a healthy young intern, aged twenty-six, the borders of the aorta are hardly discernible. *B*. On the laminagram the aortic arch is better visualized, as are the great vessels leading to the neck. The descending aorta lacks sufficient density for adequate rendition.

the thoracic aneurysms[8] and of the pulmonary arteries;[9] namely, 60 milliamperes, $2\frac{1}{2}$ to 3 seconds, 30 inch target-film distance, Lysholm grid, kilovoltage varied according to thickness, and with the spiral movement. The left anterior oblique position is used for visualizing the ascending portion of the arch of the aorta. The laminagram is usually made at a level opposite the right anterior axillary line. The left lateral position is used to record the descending portion of the arch of the aorta and the descending thoracic aorta. These laminagrams are made at levels 2 to 4 cm. lateral to the spinous processes. In the examination of each patient conventional roentgenograms are made first, and from a study of them it is possible to judge the positions and levels at which laminagrams would be most advantageous. In this way we avoid taking a needless number of sectional roentgenograms. This is the proper sequence in the use of sectional roentgenography in cardiovascular examinations, because if the structures in question are adequately demonstrated by routine methods, the use of body section roentgenography is not indicated. The following cases and illustrations will demonstrate these points and permit a discussion of various lesions of the aorta that are of clinical interest.

### ARTERIOSCLEROSIS OF THE AORTA

The aorta in a healthy young adult is difficult to visualize by either conventional or sectional roentgenography. The left anterior roentgenogram in Figure 1*A* was made of a young intern. The aorta in persons of this age is smaller, contains less calcium and fibrotic tissue, and therefore lacks the density of the aorta that is seen in older persons. Furthermore, the aortic arch is more acute and "bunched" together than is the wider arch of the mature adult. The

sectional roentgenogram in Figure 1*B* is an improvement. The great vessels entering the neck and the posterior portion of the aortic arch are fairly clear, but the descending aorta is scarcely differentiated from the surrounding tissues. Thus in children and in young adults, sectional roentgenography is not of much advantage.

It is in patients in the late forties, fifties, sixties, and beyond that age that sectional roentgenography is of value in examination of the aorta. In these patients arteriosclerotic changes have developed to various degrees. Microscopic sections through the wall of an arteriosclerotic aorta reveal that the intima is thickened and composed of dense, hyalinized connective tissue, in which acellular plaques and calcium deposits can be seen. These changes make the aortic wall thicker and of greater density as well as producing a lengthening of the aorta—all of which leads to better roentgenographic visualization. Examples of advanced arteriosclerosis are seen in Figures 2 and 3. In these illustrations note particularly the size (diameter) of the aortas and the superior clarity with which they are shown on the sectional roentgenograms. Even in these advanced cases of arteriosclerosis the diameter of the aorta is only slightly enlarged over that of individuals in the late forties and early fifties, but it is greatly lengthened, and there is a marked spread in the distance between the ascending and descending aortas.

## DISSECTING ANEURYSMS OF THE THORACIC AORTA

An important but seldom recognized complication of advanced arteriosclerosis of the aorta is the development of a dissecting aneurysm. An associated hypertension is the usual accompaniment in the formation of this complication. Shennan[10] in 1934 reviewed the world literature and collected 300 cases, but only 6 of these had been

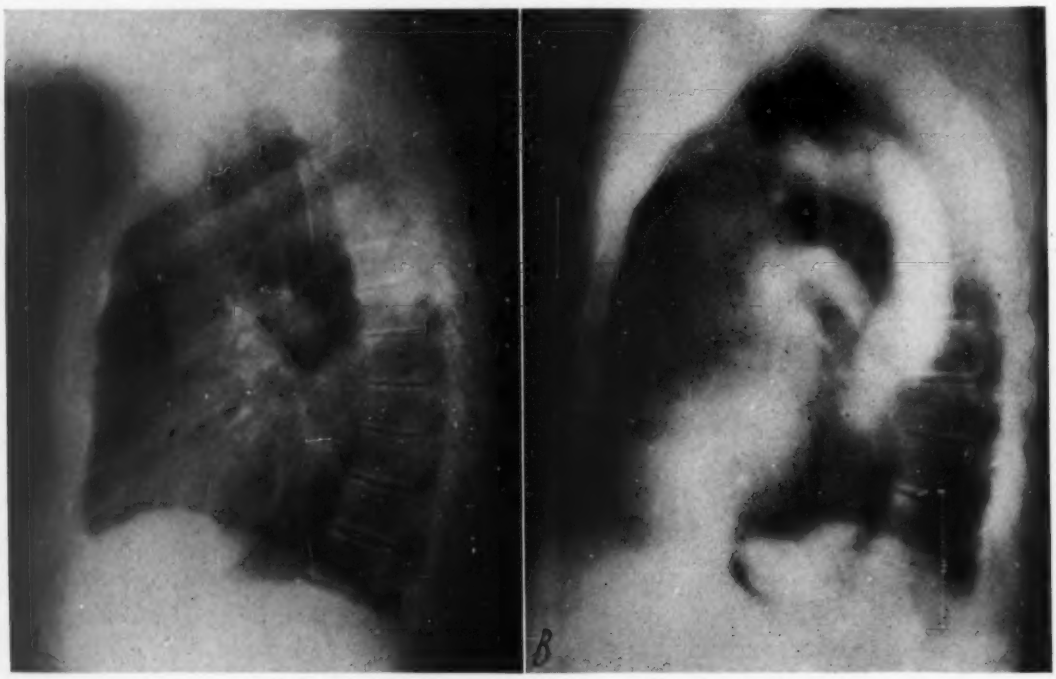


FIG. 2. Illustrates moderate arteriosclerosis of the aorta in a man, aged sixty. The aorta is lengthened, but only slightly enlarged in diameter. Blood pressure 140/85. Serology negative. *A*. The conventional left lateral view of the chest provides an unusually clear visualization of the aorta. *B*. The sectional roentgenogram affords even better definition of the aorta. Compare the aortic size in Figures 2 and 3 with those in Figures 4, 5 and 6.

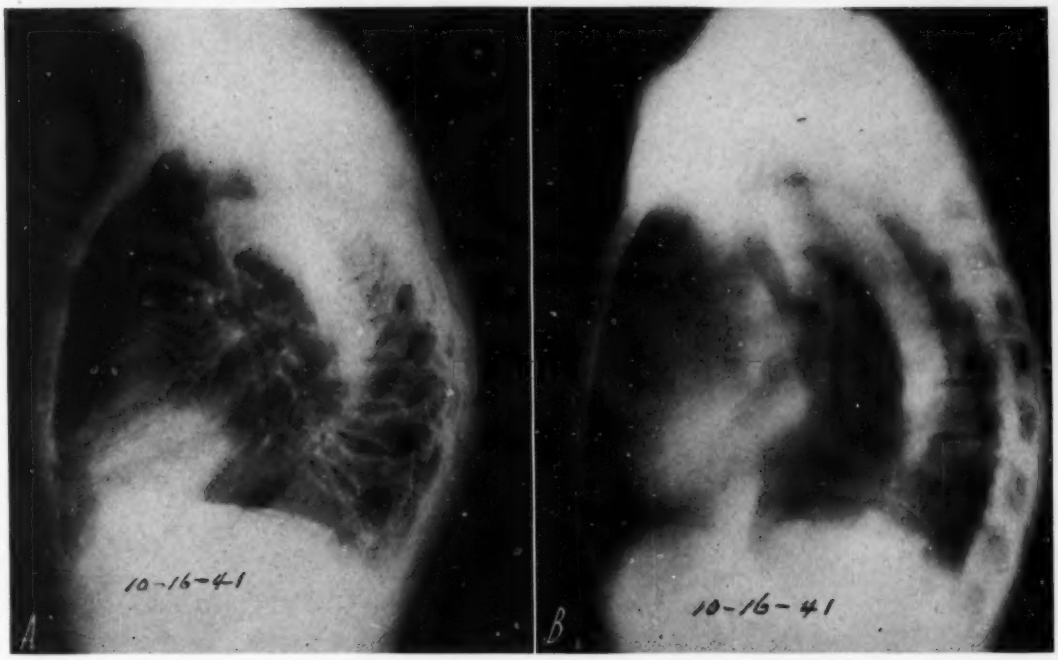


Fig. 3. In advanced arteriosclerosis, as illustrated in these roentgenograms of a woman, aged seventy-nine, there is marked lengthening and increased tortuosity of the aorta without appreciable increase in the size of the diameter of the aorta. *A*. Conventional left lateral roentgenogram of the chest. *B*. Left lateral sectional roentgenogram. Note the shadows of the great vessels leaving the aorta to enter the neck and that of the inferior vena cava.

diagnosed before death. Since then excellent clinical studies have been published by McGeachy and Paullin,[4] Leary and Weiss,[3] Rottino,[6] Ruffin, Castleman and White,[7] and a correct antemortem diagnosis is no longer a rarity. Part of the difficulty of diagnosis lay with the internists, who were not familiar with the symptoms of this complication, and part with the roentgenologists, because they were unable to demonstrate the aortic change adequately. The attempt to establish this diagnosis in the following 3 cases was the stimulus for this paper.

Case 1. The patient was a physician, aged sixty-three, who first entered the hospital in September, 1940, seriously ill with a pneumonia. The roentgenogram in Figure 4*A* was made during his convalescence. The aorta is of average size and shape for a man of his age with a hypersthenic habitus. Six months later while on a business trip he was suddenly stricken with a severe pain in the middle of the thoracic back. The pain was constant, radiated to the scapulae and required large doses of morphine for relief. Coronary thrombosis was suspected but the electrocardiogram was negative. After three days of hospitalization he returned home. On the next day he again experienced this severe pain and was hospitalized and required morphinization to control the pain. The pulse, temperature, respiration, heart sounds and laboratory examinations were all negative, including another electrocardiogram. The blood pressure was 170/102 and was equal in all extremities. A roentgenogram of the chest at this time showed a definite widening of the aortic shadow (Fig. 4*B*). A widening of this degree occurring in a short period of time together with a severe constant pain in the mid-thoracic back is the salient sign and symptom of a dissecting aneurysm. In the lateral view (Fig. 4*C*), the aortic arch appears widened, but it is not sufficiently clear to establish the diagnosis. The lateral sectional roentgenogram (Fig. 4*D*) shows the very marked increase in the width of the aortic arch and the proximal descending thoracic aorta with sufficient detail to establish the diagnosis

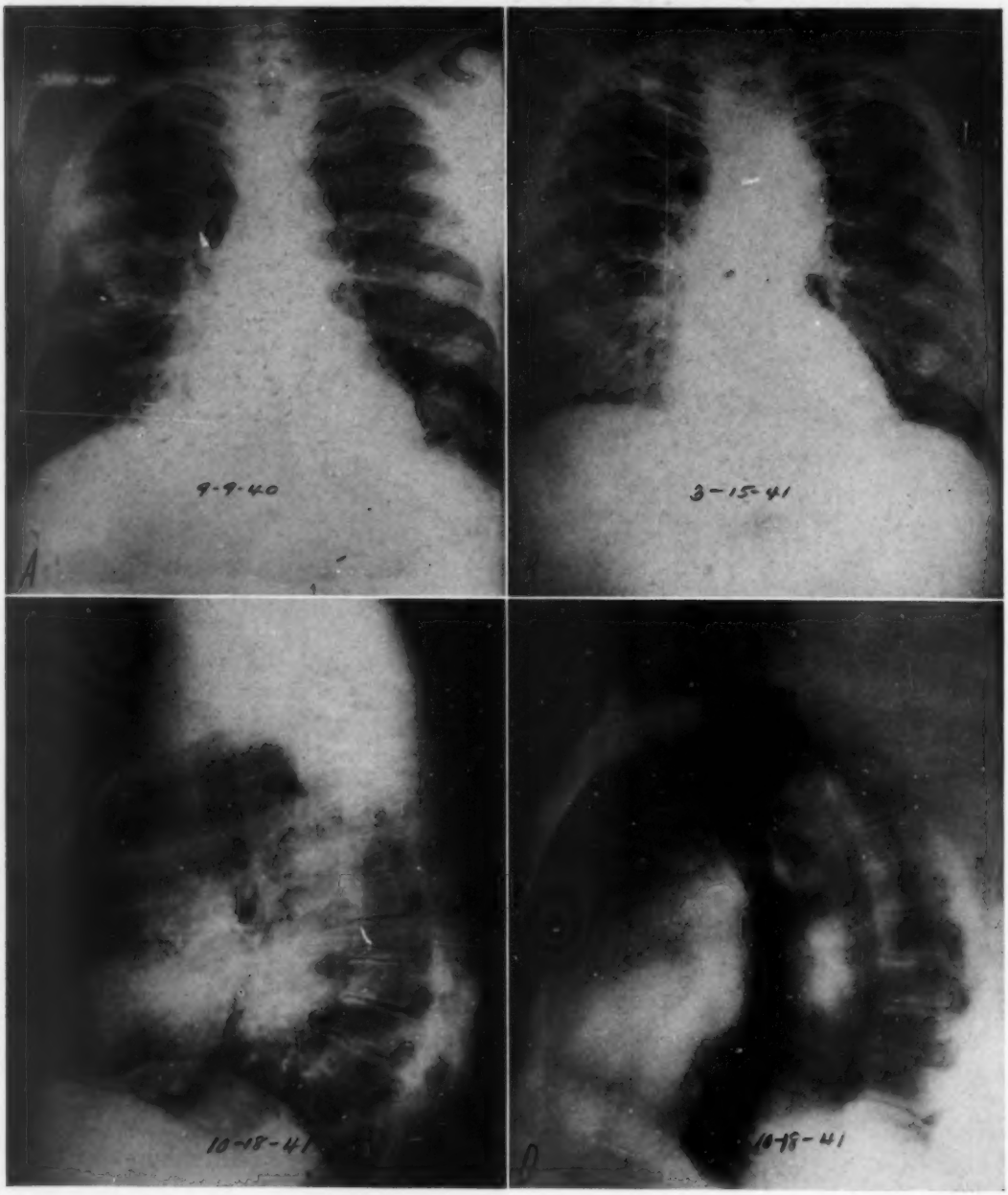


FIG. 4. Case 1. Dissecting aneurysm of the arch and descending portion of the thoracic aorta in a physician, aged sixty. *A*. Routine posteroanterior chest roentgenogram made on September 19, 1940, during his convalescence from a serious attack of bilateral pneumonia. The aortic shadow is slightly widened, but no more than is usually seen in a man of this age with a hypertension of 170/102. *B*. Posteroanterior chest roentgenogram made on September 15, 1941, at the time the patient experienced a severe boring pain in the mid-thoracic back. This degree of widening of the aortic shadow occurring in a short period of time should always suggest the possibility of a dissecting aneurysm. *C*. Left lateral roentgenogram of the chest confirms a definite enlargement of the aortic arch and proximal descending aorta. *D*. Left lateral laminagram reveals more clearly, and therefore with greater certainty, the marked enlargement of the arch and descending aorta due to the dissecting aneurysm. The trachea and bifurcation are in the same plane and are clearly shown.

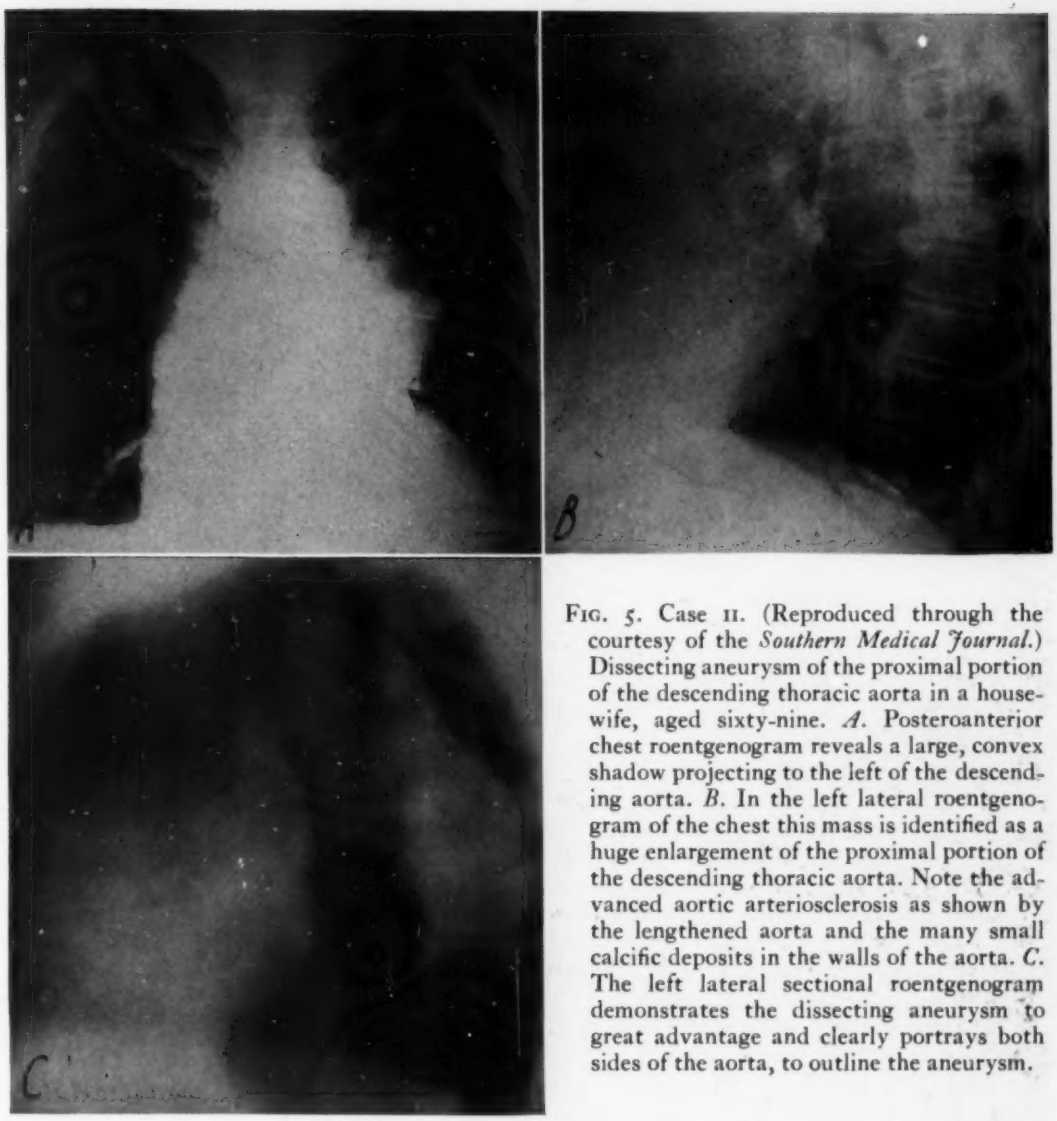


Fig. 5. Case II. (Reproduced through the courtesy of the *Southern Medical Journal.*) Dissecting aneurysm of the proximal portion of the descending thoracic aorta in a housewife, aged sixty-nine. *A.* Posteroanterior chest roentgenogram reveals a large, convex shadow projecting to the left of the descending aorta. *B.* In the left lateral roentgenogram of the chest this mass is identified as a huge enlargement of the proximal portion of the descending thoracic aorta. Note the advanced aortic arteriosclerosis as shown by the lengthened aorta and the many small calcific deposits in the walls of the aorta. *C.* The left lateral sectional roentgenogram demonstrates the dissecting aneurysm to great advantage and clearly portrays both sides of the aorta, to outline the aneurysm.

of a dissecting aneurysm with reasonable certainty. His pain gradually subsided in the following three months and he has been able to return to his work.

Case II. The second case was a housewife, aged sixty-nine, who was admitted to the hospital on April 8, 1940, during an attack of influenza. After the acute symptoms subsided she was carefully examined because of a history of a persistent cough for the past year accompanied by a dull pain in the left chest and back. The onset of these symptoms was sudden. Since then she had never felt well and her condition had been steadily growing worse. On physical examination the blood pressure was 180/108. A diastolic murmur was heard over the region of the aortic valve. Laboratory reports were negative, including the serology. The electrocardiogram revealed evidence of a left axis deviation. The first roentgenogram of the chest (Fig. 5*A*) was made the day she entered the hospital. A large, convex shadow was found in the region of the descending thoracic aorta. The appearance of this suggested the possibility of a mediastinal tumor. The heart was moderately enlarged to the left. In the left lateral roentgenogram (Fig. 5*B*) this shadow is seen to be the result of a huge enlargement of the aorta, and without doubt is a dissecting aneurysm. On the sectional roentgenogram (Fig. 5*C*) the dissecting aneurysm is beautifully pictured, and we doubt if opacification could

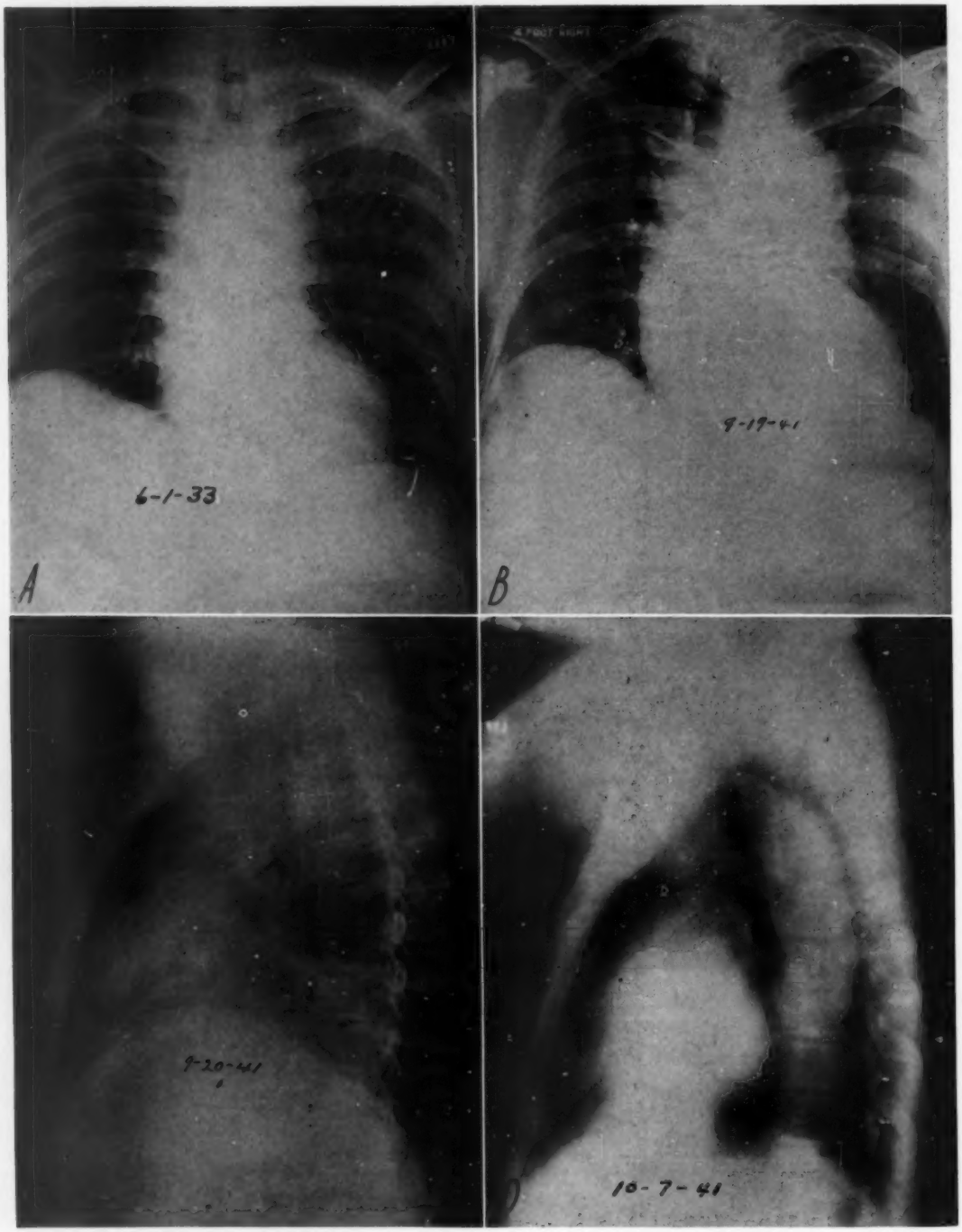


FIG. 6. Case III. Dissecting aneurysm involving the ascending portion and arch of the aorta in a male, aged fifty-two, with a hypertension of 160/90. *A*. The posteroanterior roentgenogram of the chest was made on June 1, 1933, at the time he had a severe attack of precordial pain that was considered to be a coronary thrombosis. However, in the light of subsequent developments, it seems possible that this episode was the initial break in the intima with beginning dissection. This view is compatible with the degree of widening of the aortic shadow present at this time. *B*. This chest roentgenogram was made September 19, 1941, at the time of his second attack of severe pain in the chest and back. The great enlargement of the aorta at once suggests an aneurysm. *C*. The left lateral view is difficult and unsatisfactory to interpret, as the detail is poor, due to the large size of the patient. *D*. On the left lateral laminagram the huge enlargement of the aortic arch is well demonstrated, and diagnosis of a dissecting aneurysm is as certain as it is possible to determine without autopsy confirmation.

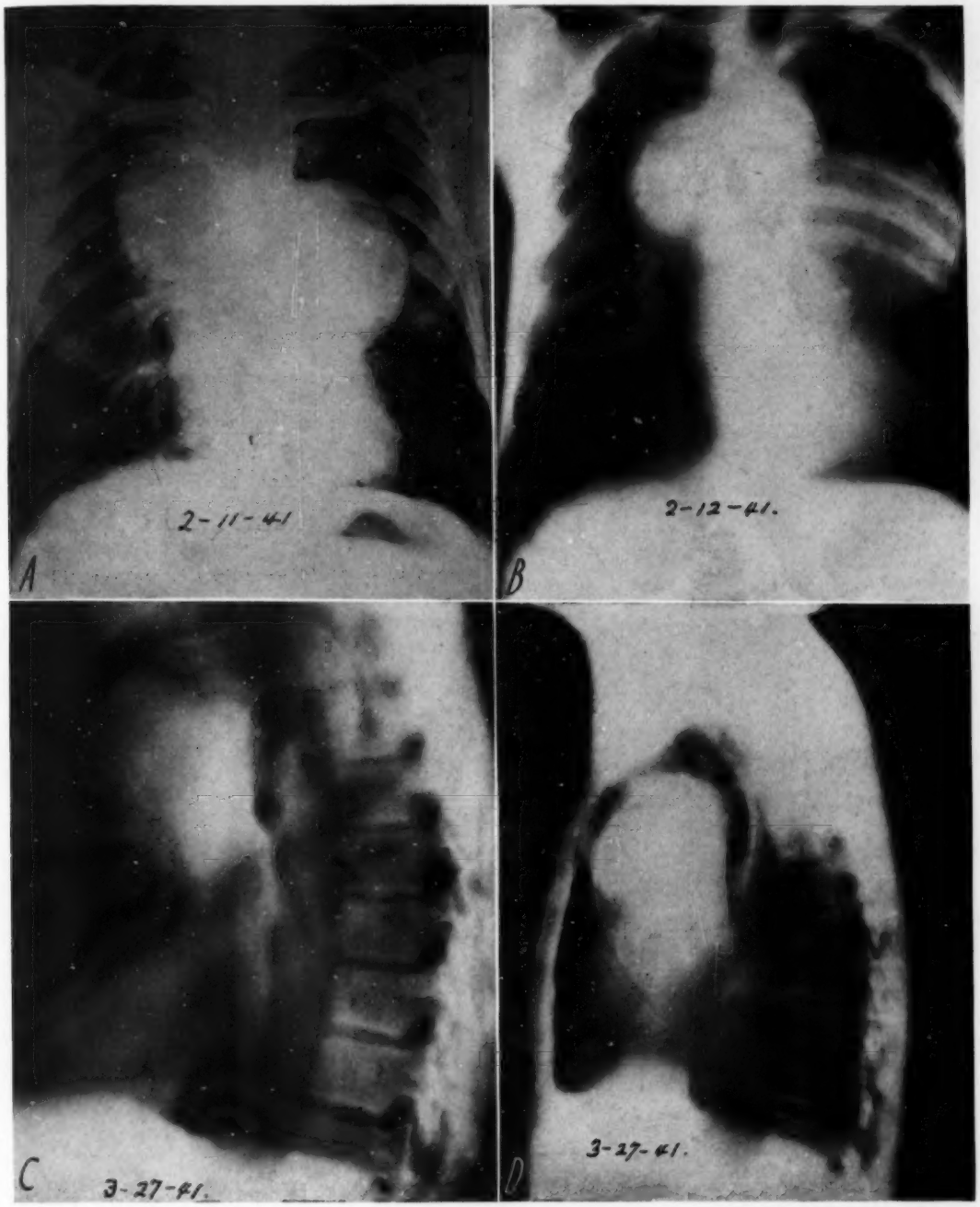


Fig. 7. Case IV. A double, sacculated aneurysm in a male, aged sixty-three. *A*. On the posteroanterior chest roentgenogram it is impossible to identify the sites of origin of the aneurysms and what segments of the aorta they involve. *B*. On the posteroanterior sectional roentgenogram the deposits of calcium in the walls of the ascending aorta and in the aneurysms are sufficiently well demonstrated to outline these structures. The mouths to both aneurysms are visible, and, since they and the ascending aorta are both in the same plane, the aneurysms both arise from this portion of the aorta. *C* and *D*. In the conventional left lateral roentgenogram both aneurysms overlie each other, and the details of each are obscured. Sectional roentgenography makes it possible to take a section through each aneurysm separately. *C* is through the large aneurysms on the left, and *D* is through the aneurysm on the right. Note the opening of the aneurysm into the aorta.

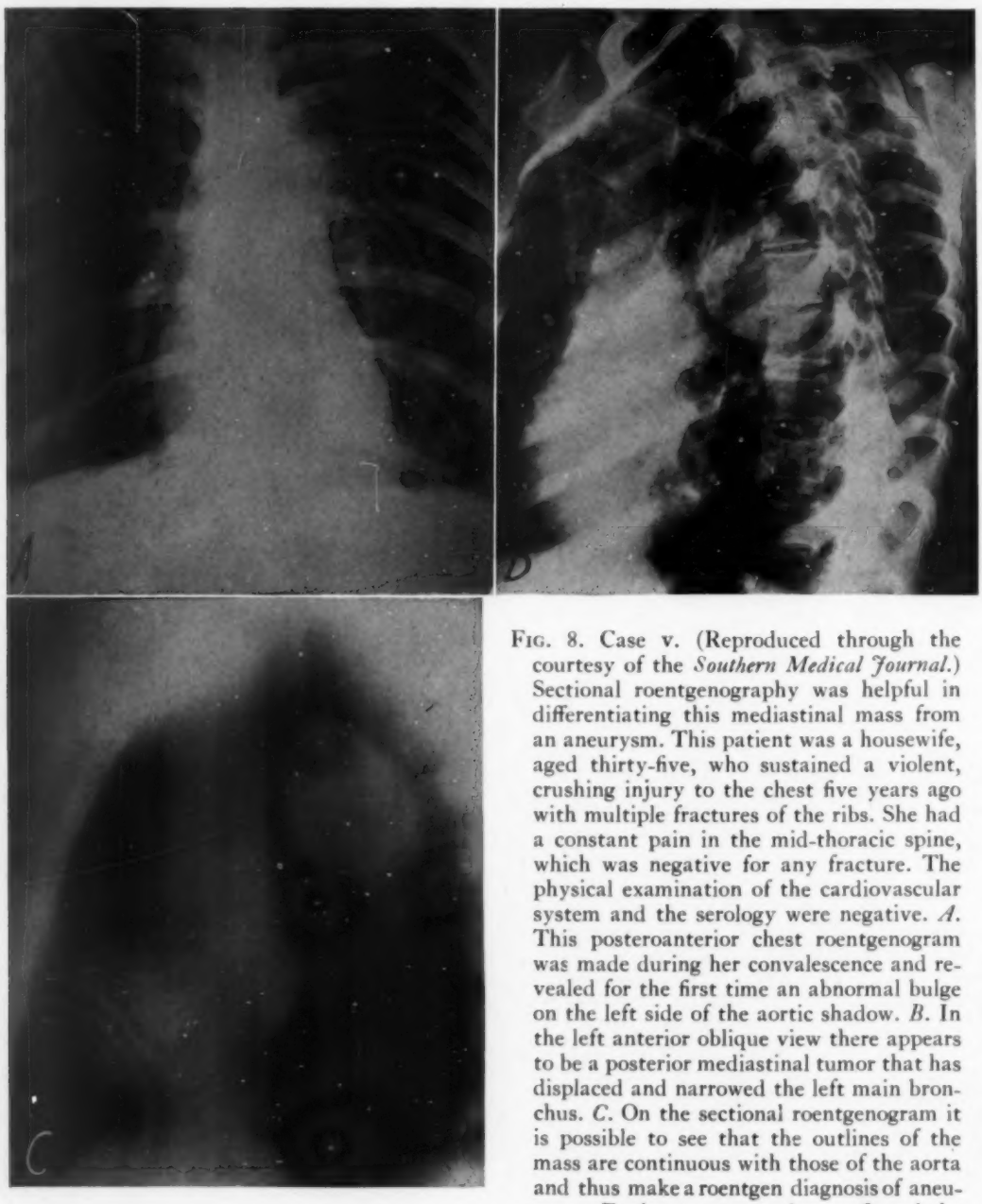

FIG. 8. Case v. (Reproduced through the courtesy of the *Southern Medical Journal.*) Sectional roentgenography was helpful in differentiating this mediastinal mass from an aneurysm. This patient was a housewife, aged thirty-five, who sustained a violent, crushing injury to the chest five years ago with multiple fractures of the ribs. She had a constant pain in the mid-thoracic spine, which was negative for any fracture. The physical examination of the cardiovascular system and the serology were negative. *A.* This posteroanterior chest roentgenogram was made during her convalescence and revealed for the first time an abnormal bulge on the left side of the aortic shadow. *B.* In the left anterior oblique view there appears to be a posterior mediastinal tumor that has displaced and narrowed the left main bronchus. *C.* On the sectional roentgenogram it is possible to see that the outlines of the mass are continuous with those of the aorta and thus make a roentgen diagnosis of aneurysm. Exploratory operation confirmed the roentgen diagnosis.

demonstrate it to better advantage. We have not been able to trace this patient since she left the hospital.

CASE III. The third case was a male, aged fifty-two, store manager. His first chest roentgenogram was made in June, 1933, when he entered the hospital with hypertension and symptoms of a coronary thrombosis (Fig. 6*A*). Even at that time he had a definite widening of the aortic shadow and it is possible that this incident was the first break in the intima with the beginning dissection that ultimately developed into an aneurysm. In 1940 he had a cerebral accident and developed an aphasia from which he fully recovered. On September 15, 1941, eight years after the first chest roent-

genogram, he was stricken with a severe pain in the lower thoracic and upper lumbar spine. The pain radiated to the left side of the abdomen. He was slightly dyspneic, pale, anxious and covered with a cold sweat. The blood pressure was 160/90. The electrocardiogram was not even suggestive of a recent cardiac infarction. The laboratory reports, including the serology, were all negative. A chest roentgenogram was made, and the great increase in the aortic width at once suggested the diagnosis of a dissecting aneurysm (Fig. 6*B*). The conventional lateral roentgenogram (Fig. 6*C*) is not particularly helpful. This patient is a big man, and the outlines of the aorta are indistinct. On the left lateral sectional roentgenogram (Fig. 6*D*) the extreme enlargement of the aortic arch and descending portion of the aorta is very evident and the diagnosis of a dissecting aneurysm is as certain as is possible without an autopsy. This patient is still able to be up and around.

These 3 cases bring out the fact that the roentgenographic examination is a most important factor in the diagnosis of dissecting thoracic aneurysms and that sectional roentgenography is a definite help.

Sectional roentgenography can be employed with equal effectiveness in visualizing sacculated thoracic aortic aneurysms. The following case of a double aneurysm illustrates very well the advantage offered by sectional roentgenography.

Case iv. The patient was a male, aged sixty-three. He had complained of dyspnea and palpitation for the past ten months. There was a marked systolic murmur over the aortic and pulmonic areas. The Wassermann reaction was 4 plus and the blood pressure 140/72. In the posteroanterior conventional roentgenogram (Fig. 7*A*) it is impossible to determine the division or divisions of the aorta that are involved by the aneurysms. A laminagram (Fig. 7*B*) at the level of the ascending aorta brings out the fact that both aneurysms arise from the ascending aorta and are directly opposite each other. An almost continuous deposit of calcium forms the outlines of these structures. By tracing the left border of the aorta one can see the opening of the larger aneurysm, the border of which is easily followed back to the mouth and across to the arch of the aorta. The mouth of the smaller aneurysm is not as prominent but can be made out. Since both aneurysms lie at the same depth and opposite each other, it is obvious that on the conventional lateral roentgenogram their shadows will be superimposed obscuring the details of each. By sectional roentgenography, however, a separate lateral film can be made of each aneurysm as shown in Figures 7*C* and 7*D*. The sectional examination is not necessary to establish the diagnosis in this case, but it does demonstrate another way in which sectional roentgenography can be used and which may be of value in the diagnosis of other cases.

## Differential Diagnosis between Aneurysms and Mediastinal Tumors

Sectional roentgenography occasionally has been helpful in distinguishing between aneurysms and mediastinal tumors. It is frequently possible to visualize a questionable mass with greater clarity on the sectional roentgenogram, and in this way determine if its outlines are continuous with those of the aorta. If so, then it is in all probability an aneurysm as both are at the same level. The following case is an excellent example of this point, and even though it has been previously published,[8] it seems worth repeating.

Case v. The patient, a female, aged thirty-five, received a severe crushing injury to the chest in an automobile accident five years ago. At that time she complained of a severe pain in the mid-thoracic spine. Roentgenograms of the spine, the physical examination, and the serology were negative. A chest roentgenogram revealed an abnormal bulge in the region of the distal part of the aortic arch (Fig. 8*A*). In the left anterior oblique view it appears to be a rounded mass causing pressure on the left main bronchus (Fig. 8*B*). The overlying and obscuring shadows are eliminated in the left anterior oblique laminagram (Fig. 8*C*), and it is possible to see that the outlines of the mass are continuous with those of the aorta anteriorly and posteriorly, which identifies it as an aneurysm, and we believe it to be a traumatic aneurysm.

## Conclusion

*In conclusion*, the advantages and limitations of sectional roentgenography when applied to the study of aortic arteriosclerosis, dissecting aneurysms and saccular aneu-

rysms of the thoracic aorta can be summarized as follows:

1. Body section roentgenography is a new method of examining the thoracic aorta that is of definite value in the diagnosis of arteriosclerosis, of dissecting aneurysms and of sacculated aneurysms. The examination is simple, can be done by a technician, and is not uncomfortable or hazardous to the patient.

2. The laminagraph of Kieffer and Moore is well suited for taking sectional roentgenograms of the aorta because the unwanted shadows are dispersed in every direction to provide a uniform background.

3. The conventional, routine roentgenographic examination should always be made first, as a study of these roentgenograms will aid in determining the positions and levels at which to make laminagrams.

4. Sectional roentgenography of the aorta should not be used as a routine procedure but as a special examination in selected cases. It is least applicable in children and young adults and most effective in older persons with arteriosclerosis.

5. Emphasis is placed on the importance of recognizing the symptoms of dissecting aneurysms of the thoracic aorta so that suspected patients would be submitted to a complete roentgen study including sectional roentgenography.

6. Adequate roentgenographic visualization of thoracic dissecting aneurysms is the cardinal factor in establishing this fairly common but seldom recognized diagnosis. Sectional roentgenograms, in our experience, provide the most satisfactory method of demonstrating these aneurysms.

7. Saccular aneurysms can be visualized to the same advantage and can occasionally be distinguished from mediastinal tumors when a continuous outline is demonstrated between the mass and the aorta.

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# PRACTICAL CARDIOKYMOGRAPHY

## ITS SIGNIFICANCE IN EVALUATING CARDIAC FUNCTION

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THE theoretical basis of cardiokymography, as well as the changes which are noted to accompany structural cardiac abnormalities, has been discussed in detail in recent medical literature. It is our purpose to direct attention to the contributions roentgen kymography may offer in the evaluation of cardiac functional capacity in the presence of heart disease or extracardiac disorders.

The conclusions represent a study of a series of 1,000 cardiokymograms during 1940 and 1941. The indications for these studies were structural and functional cardiac abnormalities, as well as diagnostic aid in differentiating various juxtacardiac masses.

The apparatus employed was a conventional type; namely, a multiple slit kymograph with a grid width of 12 mm. and a slit width of 0.4 mm. The target film distance was 30 inches, with an exposure time of 1.5 seconds. Posteroanterior exposures were routinely employed.

An introductory discussion of the normal kymographic silhouette will be appropriate (Fig. 1).

In the analysis of cardiograms the appearance of the left cardiac contour receives the primary and precise evaluation; the pulsations on the right, however, while they are also of fundamental importance, especially in a consideration of variations in cardiac rhythm and function, cannot always be analyzed with the same precision. The reason for this will be discussed in the text.

Along the lower left border may be seen the characteristic pulsations of the left ventricle. The diastolic period is biphasic with an initial rapid filling followed by a stage of slower filling of variable character; when this diastolic pulsation is flattened, it is described as a plateau. In many cases

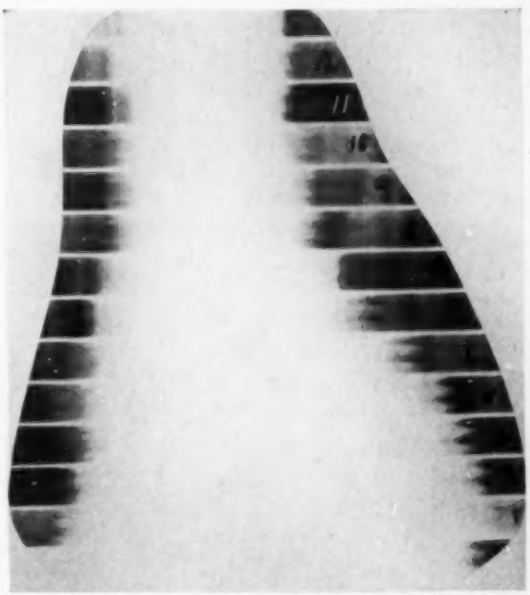
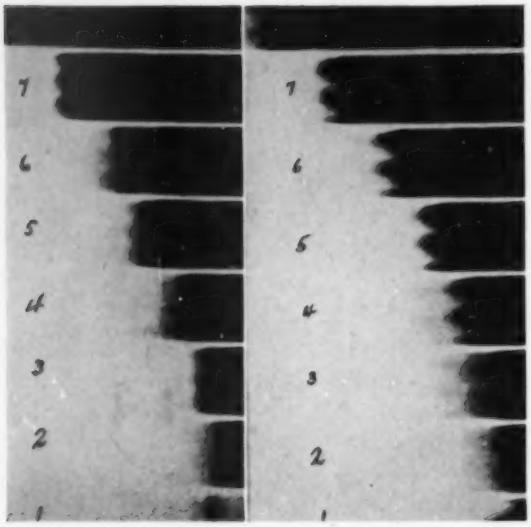


FIG. 1. Normal male, aged twenty-seven. Frames 3 to 7 on right show right auricular and ventricular pulsations; frames 8 to 12 show ascending aorta and vena cava. Frames 3 to 6 on left show left ventricular pulsations; frame 7 shows left auricular and ventricular pulsations; frames 8 to 12 depict the aorta.

it is replaced by a peak due to a shortened filling phase. This is followed by a sharp inward impulse representing a ventricular systole.

The aortic pulsations are in opposite phase to that of the left ventricle; namely, the outward thrusts represent systole, and the troughs obviously represent the diastolic phases. These expansions and recoils




A B

FIG. 2. *A*. Male, aged fifty-two. Hypertensive; arteriosclerotic; pulse 140+. Roentgen kymogram of left ventricle reveals rapid and low amplitude pulsations. *B*, roentgen kymogram of same patient one week later after digitalization shows normal amplitude in frames 4 to 7. Pulsations almost obscured in frames 2 and 3 due to myocardial infarction.

of the thoracic aorta are evident in Figure 1. There is a perceptible lag between ventricular pulsations and aortic impulses. Since each frame represents the same time interval, the time relationship between the various chambers may be compared by measuring the position of the impulses of the corresponding frame. The pulmonary artery pulsations, similar in character to the aorta, though not as vigorous or sharply peaked, may be visualized in the upper frames. The pulsations of the left auricular appendage are characteristically barely perceptible.

Progressing from below upward along the right border, the right ventricular contractions may be seen; they are similar in character to those of the left ventricle. In the region of the right auricle, two types of pulsations are evident. There is a transmitted wave of a ventricular character which is dominant, as well as an independent auricular impulse. The latter may be seen as a low amplitude rhythmic wave. It is often difficult to determine the character of these waves in the presence of marked pulmonary congestion. Along the upper portion of the right border, the contours represent the combined effect of the superior vena cava as well as the pulsations of the aorta.

Besides evaluating the character and the time relationship of the various pulsations, it is important to consider their amplitude. In a characteristic ventricular wave this may be done by measuring the distance between the peak and the trough. While it is true that such measurements are related mainly to the horizontal component of motion, they are nevertheless of significance. With the above described technique, the amplitude of normal ventricular curves varies from 4 to 8 mm.; for such measurements, frames 3, 4, 5 and 6 on the left are most reliable. The lower two frames, while they show pulsations, are not as valid guides; their amplitude is usually depressed. This is probably due to the dominance of the vertical and rotary components over the horizontal. The pulsations in these lower frames may be completely obliterated by minimal pericardial effusion. The presence or absence of such a complication should be determined in analyzing the amplitude of corresponding frames of both sides.

Cardiac physiologic and functional capacity may be indicated kymographically by a consideration of rate and rhythm as well as the intensity of the pulsatile phenomena.

Tachycardia is evidenced by an increase in the number of pulsations in each frame. In sinus tachycardia, the auricles and ventricles exhibit equal, regular and frequent pulsations (Fig. 2, *A*).

In the presence of a totally irregular ventricular rhythm, there is noted varying amplitudes of the left ventricular pulsations in a single frame. This is apparently related to a shortening and, hence, inequality of the diastolic phases. In auricular fibrillation, the ventricles exhibit these phenomena, usually at a rate of between 60 and

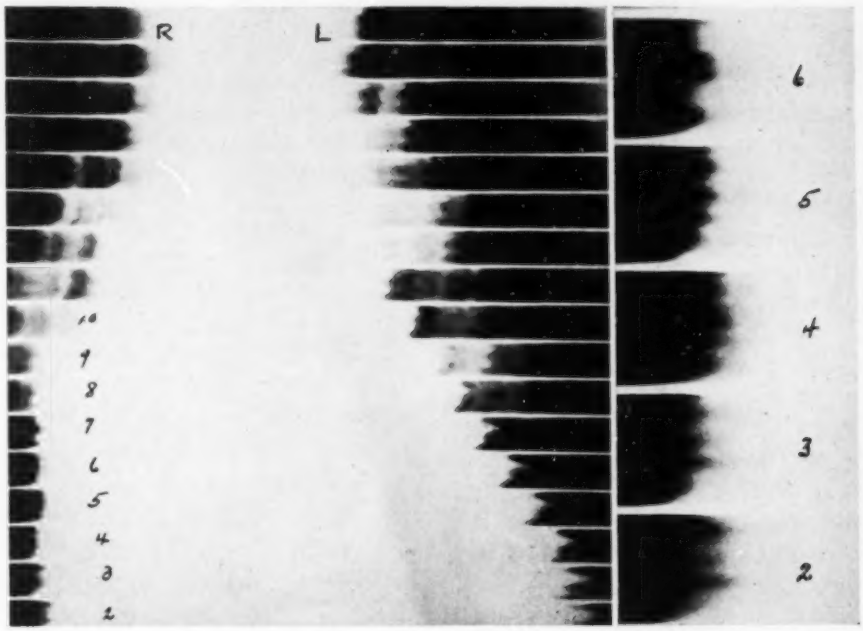



Fig. 3. *A*. Male, aged fifty-seven. Pulse 88, irregular in rate; presystolic murmurs at apex; blood pressure 148/90; electrocardiogram, auricular fibrillation. Roentgen kymogram shows on left pulsations of irregular amplitude in frames of ventricle. On right, frames 2 to 10 show the pulsations of right ventricle and a fibrillating right auricle. *B*, magnified view of frames 2 to 6 of right side.

100 per minute, while the auricular waves along the right cardiac border appear as an irregular, poorly defined, serrated pattern (Fig. 3, *A* and *B*). Frequent ventricular extrasystoles may give a similar ventricular pattern; the extrasystole appears as a wave of reduced amplitude. The auricular pulsations on the right, however, are well defined.

Cardiac functional capacity may, too, be properly indicated. Typically, there is noted in cardiac failure a reduction in ventricular amplitude. From a normal level between 4 and 8 mm., the amplitude declines below 4 mm. It is true that this does not truly represent the vertical or rotary phenomena. However, in the presence of cardiac hypertrophy or dilatation, the amplitude of pulsation may be reduced without any gross reduction in cardiac output. Nevertheless, there is still found a close correlation between cardiac failure and the marked reduction in amplitude in the ventricular pulsations. Here, there is often noted a similar variation in aortic amplitude.

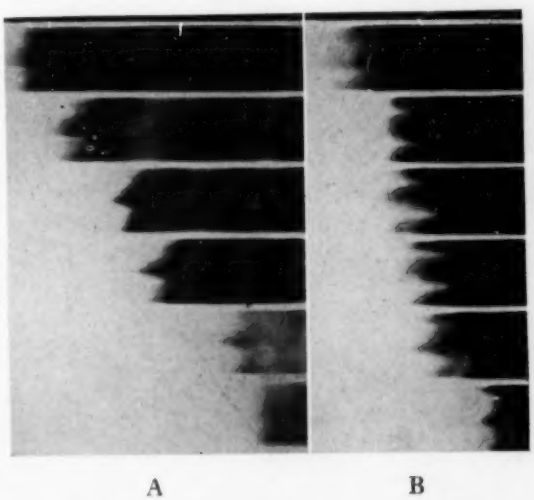



Fig. 4. *A*. Male, aged fifty-eight. Clinical diagnosis: myxedema. Pulse 68; basal metabolic rate −28 per cent. *B*, same patient after thyroid therapy. Pulse 104; basal metabolic rate −6 per cent. Compare the amplitude and rate of left ventricular pulsations in the two illustrations.

In the presence of cardiac failure, the administration of digitalis produces recognizable kymographic changes. There is noted a gradual reduction in cardiac rate. The ventricular pulsations increase in amplitude until they may reach a normal or higher level, while the diastolic phase may become prolonged (Fig. 2, *A* and *B*). These changes have been found to occur consistently in a series of cases studied kymographically before and after digitalization. Following the treatment of beriberi and myxedema, similar kymographic changes are observed (Fig. 4, *A* and *B*).

In conclusion, it is felt that cardiokymography is of value in considering cardiac physiologic and functional capacity. It is further evident that though the wave recorded in a single frame is usually the pattern of a single muscular unit, the kymograph does not record the vertical and rotary phenomena in any precise fashion. Moreover, cardiac size and tone is an influencing factor upon the pulsatile cardiac amplitude.

Nevertheless, it is felt that if one is conscious of the limitations referred to above, cardiokymography can contribute much information of clinical value.

SUMMARY

1. Attention is directed to the value of roentgen kymographic study as an index of cardiac rhythm and functional capacity.

2. It is a simple and precise record of heart function in cardiac or extracardiac disorders.

3. Its value in prognosticating the response to therapeusis is emphasized.

# ANGIOCARDIOGRAPHIC ANALYSIS OF THE CARDIAC CONFIGURATION IN RHEUMATIC MITRAL DISEASE

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THE cardiac configuration in rheumatic mitral stenosis ordinarily is sufficiently distinctive in the conventional roentgenogram to suggest the diagnosis of the lesion. However, analysis of the cardiac contours, especially the left, has been the subject of considerable discussion. In the past, studies have been based on postmortem material. Correlation with the gross anatomical topography has been made ordinarily, although some investigators have made roentgen studies after chamber opacification in the intact cadaver.

As a result of these studies, there is a difference of opinion regarding the analysis of the segment of the left cardiac contour situated between the aortic knob and the left ventricle. Part of the confusion is due undoubtedly to the lack of uniformity in nomenclature. In the present discussion the term "pulmonic conus" is used to designate that portion of the right ventricle immediately below the pulmonary valve, i. e., the outflow tract. Although this is the accepted standard terminology, the term has been applied to the base of the pulmonary artery, which we regard as the pulmonary sinus. Furthermore, atrium and auricle will be used for those structures which sometimes are referred to as auricle and auricular appendage respectively.

In the mitral configuration, the middle segment of the left cardiac contour may be divided into two arcs. The upper arc, immediately caudad to the aortic knob, represents the main pulmonary artery or its left branch. All authors agree with this interpretation. Which structure forms the lower arc, however, has been a controversial issue. Groedel[3] concluded, on the basis of postmortem studies, that, in mitral stenosis, this arc is formed by the left atrium solely. Assmann[1] suggested, on the basis of similar studies, that the left auricle rather than the atrium was the component. Both agreed that only in advanced cases does the pulmonic conus contribute to the formation of this arc. Holzman,[4] Zdansky,[14] Uhlenbruck,[13] and Teschendorf[12] concur with this interpretation.

An opposing interpretation is advanced by Roesler,[8] Laubry *et al.*[5] and Dressler.[2] These authors, also on the basis of postmortem studies, conclude that in mitral stenosis the pulmonic conus forms the lower arc of the mid left cardiac contour. They emphasize that, with rare exceptions, the left atrium and auricle do not appear on the left border. This concept is accepted by some American cardiologists and roentgenologists[3] who attribute any prominence of the middle left segment to enlargement of the pulmonic conus. Indeed this was approximately the interpretation accepted by one of the present authors.[9] On the other hand, Robb and Steinberg,[7] who first employed angiocardiography in the study of rheumatic heart disease, disagreed with this interpretation.

Since postmortem studies led to such divergent conclusions, it was evident that studies made during life would be desirable. Angiocardiography was therefore employed in 28 cases, using the multiple roentgen exposure technique.[10,11] Diodrast 70 per cent (Winthrop) was injected rapidly intravenously as described by Robb and Steinberg.[7] The examinations were preceded in each case by complete clinical, electrocardiographic and phonocardiographic, as well as conventional roentgen studies. Our conclusions are based upon a correlation of these findings.

The cases were selected both from the

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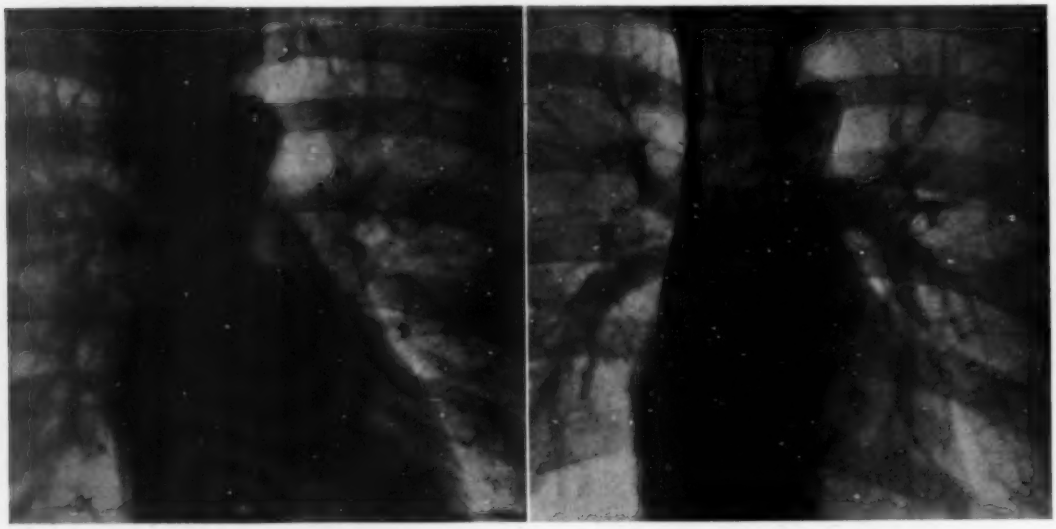

FIG. 1. Case 10. Mitral stenosis. Angiocardiography. Roentgenogram on the left shows opacification of the left auricle, left ventricle and aorta. Roentgenogram on the right shows right auricle, right ventricle and pulmonary arteries.

in-patient and out-patient departments so that the group might include all stages of mitral disease. The cases therefore include examples of mitral insufficiency and stenosis, with and without involvement of other valves and with varying degrees of atrial enlargement.

## CONFIGURATION OF THE HEART IN THE NORMAL ADULT

Angiocardiography has confirmed the usual concept of the formation of the cardiac contour except as regards the middle left segment. This segment, in the postero-anterior position, is defined as extending

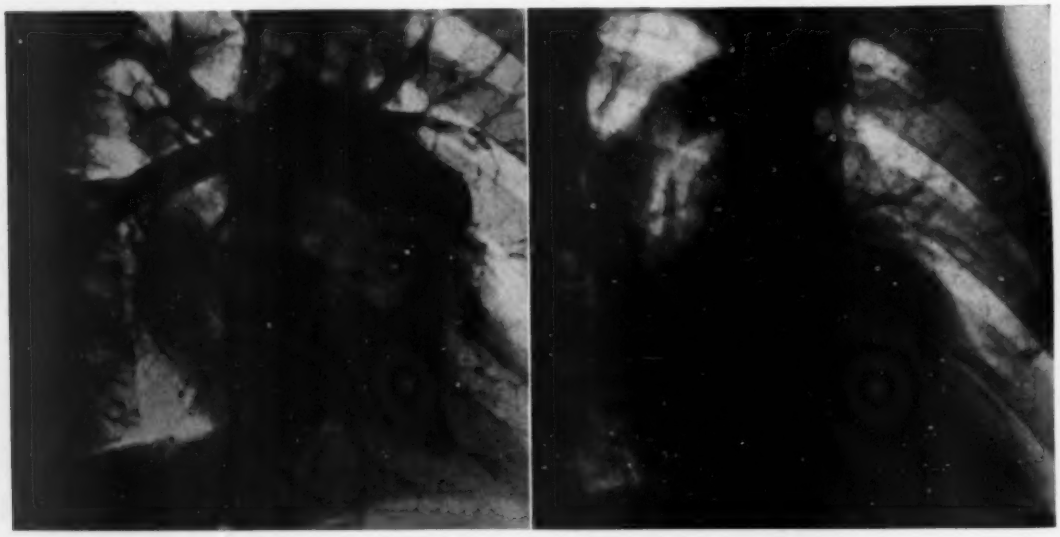

FIG. 2. Case 10. Angiocardiography made in the right anterior oblique position. Roentgenogram on the left shows right auricle, right ventricle and pulmonary artery.

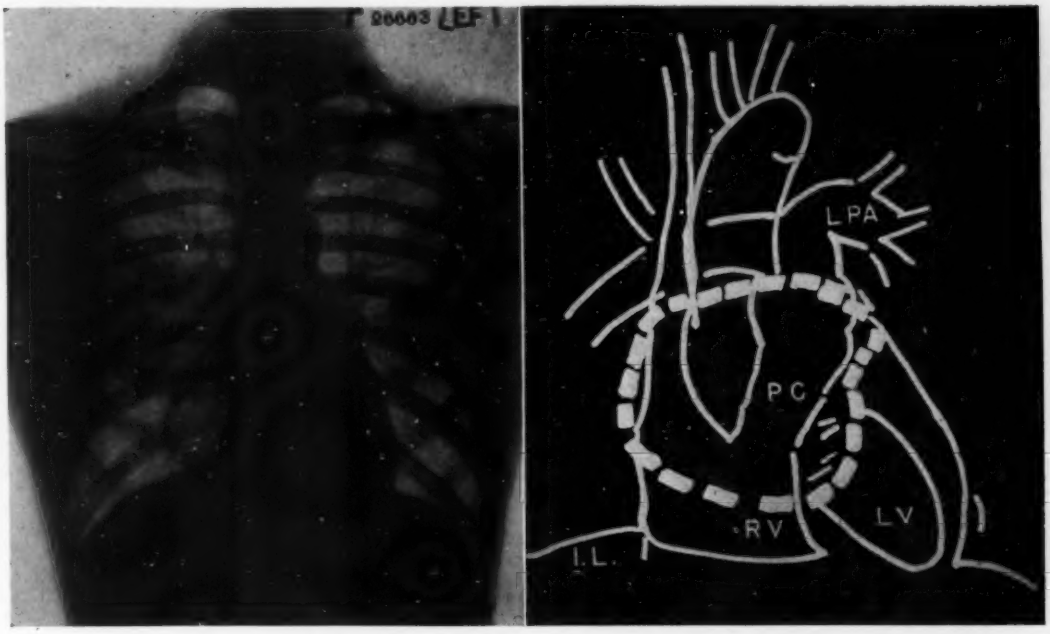


Fig. 3. Case 10. Mitral stenosis. Conventional posteroanterior roentgenogram and composite diagram of the findings illustrated in Figure 1.

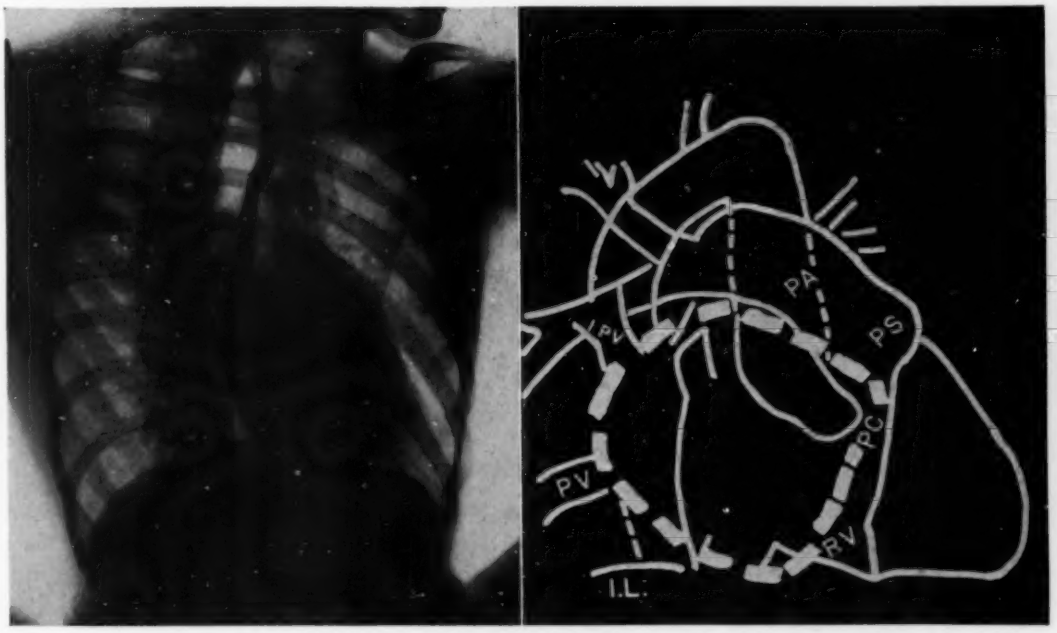


Fig. 4. Case 10. Mitral stenosis. Conventional right anterior oblique position with barium in the esophagus and composite diagram derived from Figure 2.

cephalad from a point about which "see-saw" motion takes place (point "G" of Vaquez and Bordet) to the junction of the contour with the aortic shadow. This has been described in the past as being formed by the left auricle (in some cases), pulmonic conus and pulmonary artery in this order passing cephalad. Angiocardiography has clearly shown that the pulmonary valve is situated well within the cardiac shadow. Hence, the pulmonic conus cannot possibly reach the cardiac contour. In fact, the middle segment has been found to be composed of the pulmonic artery with more or less of the left auricle caudad and sometimes by the edge of the main left pulmonary artery cephalad. Occasionally the pulmonary sinus produces a separate curve at the base of the pulmonary artery.

Our investigations confirmed the observation that the right cardiac border is made up of the right atrium in the normal individual. It is difficult to place the position of the right ventricle precisely, because only the cavity is opacified. However, the width of the ventricular muscle can be estimated and added. This usually falls well within the shadow of the opacified right atrium.

In the left oblique position, the usual analysis of the contours has been found correct. In this position also, the right border is composed of the right atrium. Where the border of the atrium joins the auricle a small notch may be seen. It is worthy of special note that the aortic valve and at least one inch of the ascending aorta are hidden in the cardiac shadow. The usual analysis of the right oblique configuration is also confirmed, except again that the pulmonic conus does not enter the left contour. The middle left segment in this position is composed of the pulmonary artery until the patient is turned into a marked oblique position.

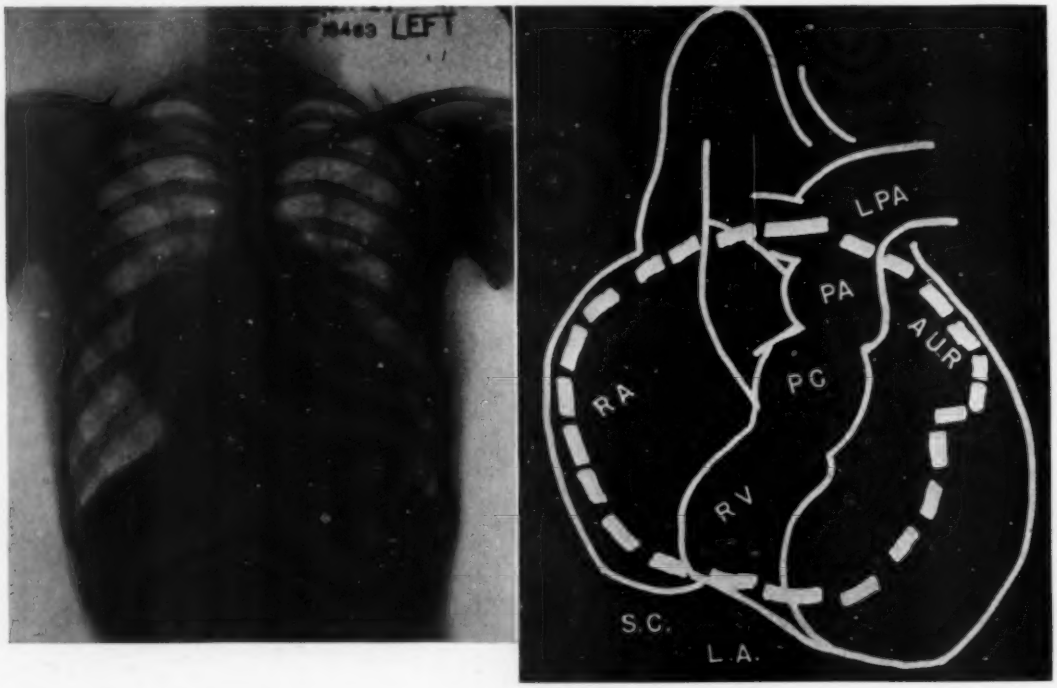


FIG. 5. Case 13. Mitral stenosis. Giant left auricle. Conventional posteroanterior roentgenogram on the left. Composite diagram on the right obtained from angiocardiography.

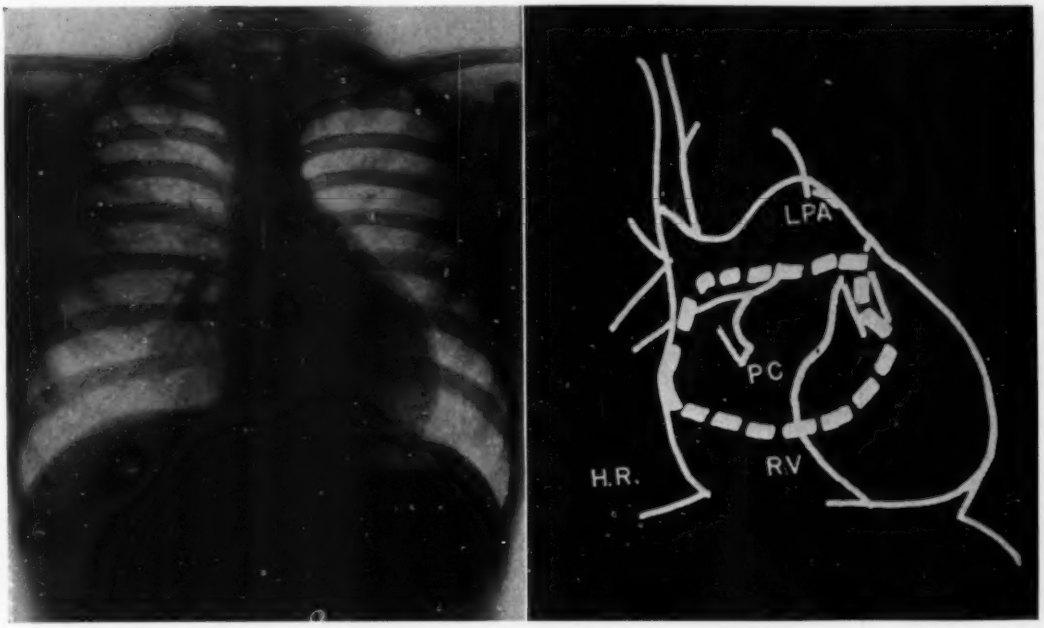


Fig. 6. Case 19. Mitral stenosis and insufficiency. Conventional posteroanterior roentgenogram with contour analysis obtained by angiocardiography.

MITRAL STENOSIS

Eleven cases with a typical mitral configuration were studied (Cases 1–11). These cases are particularly suited to angiocardiographic study because the altered dynamics in mitral stenosis results in stasis in

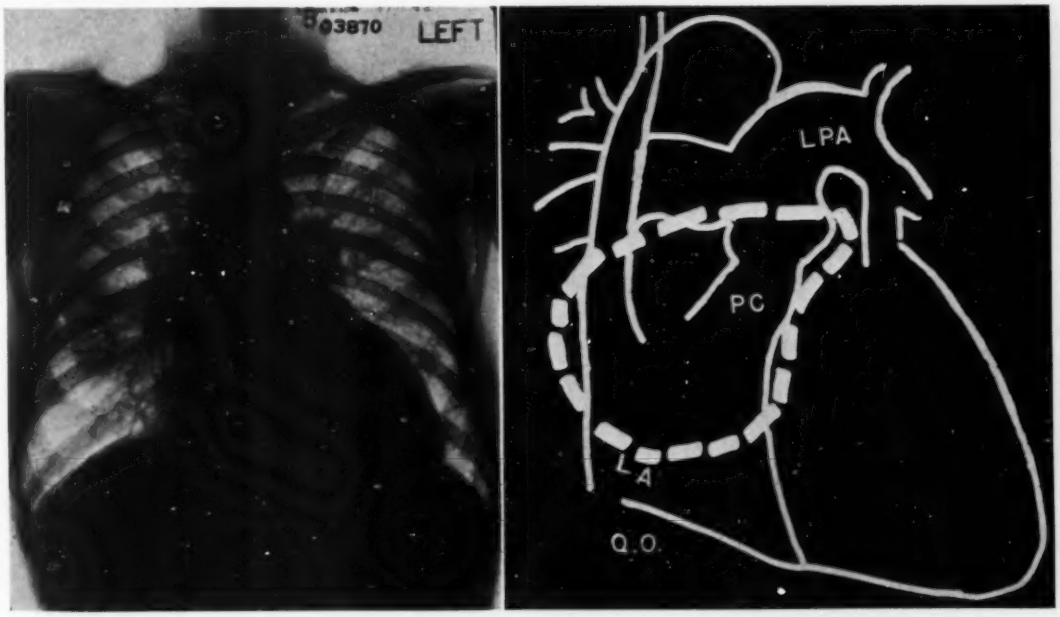


Fig. 7. Case 26. Predominant aortic insufficiency. Conventional posteroanterior roentgenogram with contour analysis obtained by angiocardiography.

TABLE I

| Case No. | Clinical Diagnosis | Name | Sex | Age | First Attack Rheumatic Fever | Recurrence Rheumatic Fever | Heart Failure | Clinical Symptoms and Findings |
|---|---|---|---|---|---|---|---|---|
| 1 | Mitral stenosis; mitral insufficiency | A.C. | F | 20 | No rheumatic history. History of frequent colds | None | None | Moderate dyspnea on effort. Occasional cough with blood-streaked sputum. Murmur discovered at age of 10. Blood pressure 110/80 |
| 2 | Mitral stenosis; mitral insufficiency | G.H. | F | 39 | Chorea at 13 yr. | Rheumatic fever at 17 yr. | At age of 36 yr. | Duodenal ulcer. No cardiac symptoms. Blood pressure 116/60 |
| 3 | Mitral stenosis and insufficiency; tricuspid insufficiency | P.B. | F | 35 | 12 yr. | None | 24 and 35 yr. | Well up to 3 yr. ago followed by onset of auricular fibrillation. Marked right heart failure with pulsating liver. Blood pressure 112/78 |
| 4 | Mitral stenosis and insufficiency | B.P. | F | 40 | 14 yr. | 32 yr. | At present | Palpitation on slight effort. Slight pretibial edema. Liver and lungs negative. Blood pressure 130/95 |
| 5 | Mitral stenosis and insufficiency; aortic insufficiency | S.G. | M | 16 | 8 yr. | 15 yr. 16 yr. | At age of 16 yr. | Arthralgia and swelling of joints, epistaxis. Liver 2–3 cm. below costal margin. Systolic thrill over apex. Blood pressure 112/52 |
| 6 | Mitral stenosis and insufficiency; aortic stenosis and insufficiency | D.I. | M | 14 | 12 yr. | 14 yr. | | Sore throat, epistaxis, slight cough. Precordial pain. Blood pressure 90/50. Bilateral pleural effusion which disappeared following diodrast |
| 7 | Mitral stenosis and insufficiency | S.C. | F | 39 | 10 yr. | None | 32 up to present | Increased dyspnea on exertion. Progressive left and right heart failure. Marked hepatic enlargement. Venous distention. Systolic thrill over apex. Blood pressure 104/68 |
| 8 | Mitral stenosis and insufficiency; aortic insufficiency | K.C. | F | 30 | 3 yr. | 11 yr. | None | Murmur discovered at age of 8 years. Asymptomatic at present |
| 9 | Mitral stenosis and insufficiency; aortic insufficiency | T.V. | M | 19 | Frequent colds as child | 18 yr. | None | Murmur of mitral stenosis discovered at age of 15. Diastolic thrill at Erb's area. Pulmonary infiltration of undetermined etiology. Asymptomatic. Blood pressure 130/50 |
| 10 | Mitral stenosis and insufficiency | I.L. | M | 36 | 16 yr. | None | None | Symptoms due to duodenal ulcer. No cardiac symptoms. Presystolic thrill at apex |
| 11 | Mitral stenosis and insufficiency; aortic stenosis and insufficiency | J.C. | M | 13 | 9 yr. | 13 yr. | 13 yr. | Otitis media at 12. This recurred with rheumatic fever at present admission. Development of dyspnea. Subacute bacterial endocarditis (*Streptococcus viridans*) briefly before discharge. Blood pressure 104/30 |
| 12 | Mitral stenosis and insufficiency | A.M. | F | 56 | 32 yr. | None | None | Sharp pain in left axilla aggravated by breathing for 2 mo. Moderate dyspnea on exertion. Blood pressure 120/60 |
| 13 | Mitral stenosis and insufficiency | S.C. | M | 16 | 11 yr. | 15 yr. | 15 and 16 yr. | Heart failure for past 1½ yr. Liver 6 cm. below costal margin. Systolic thrill at apex. Marked precordial bulge. Blood pressure 104/70 |
| 14 | Mitral stenosis and insufficiency | S.P. | M | 25 | 15 yr. | None | None | Patient had palpitation and dyspnea on exertion for the first time one year ago |

Table I

| Electrocardiogram | Phonocardiogram |
|---|---|
| Regular sinus rhythm, tendency to right axis deviation. P waves notched and prominent. RT2,3 slightly depressed, T3 diphasic. Tracing suggests right auricular and right ventricular enlargement. No digitalis | Systolic murmur over apex of low amplitude. Diastolic murmur over apex with presystolic accentuation. Opening click of mitral valve |
| Regular sinus rhythm, P waves wide and notched, RT2,3 slightly depressed, T3 diphasic. Tracing suggests auricular enlargement | Systolic and diastolic murmur over apex with occasional presystolic accentuation. Opening click of mitral valve |
| Auricular fibrillation. Tendency to right axis deviation. Small Q2,3. RT1,2,3 slightly depressed. T2 diphasic, T3 inverted. Tracings suggest right ventricular enlargement. Digitalis had been given | Early systolic murmur and diastolic murmur over the apex which starts after opening click of mitral valve. Murmurs are of very high frequency and moderate amplitude. On auscultation murmur had a musical character. Liver and venous pulses suggest presence of tricuspid insufficiency |
| Auricular fibrillation with slow ventricular rate. QRS slurred. Digitalis had been given | Faint systolic and prolonged diastolic murmurs best heard in the left parasternal area in the 5th intercostal space. Opening click of mitral valve over apex |
| Regular sinus rhythm. PR interval 0.24 seconds. P waves wide and notched. Tracing suggests auricular enlargement and impairment of conduction system | Faint systolic and prolonged diastolic murmurs best heard to the left parasternally. Opening click of mitral valve |
| Regular sinus rhythm. Tracing within normal variation | Systolic and prolonged diastolic murmurs over the apex. Systolic and early decrescendo diastolic murmur over Erb's and aortic areas |
| Regular sinus rhythm. Right axis deviation. P waves wide and notched. Small Q2,3. RT1,2,4 slightly depressed. T2,3,4 diphasic. Tracing suggests auricular and right ventricular enlargement | Systolic and prolonged diastolic murmur over apex with presystolic accentuation. Occasional opening click of mitral valve |
| Regular sinus rhythm. PR interval 0.22 second. P waves wide and notched. QRS high. Small Q2,3. T2 diphasic, T3 inverted. Enlargement of auricles and both ventricles. | Split first and second sounds at the base. Systolic and diastolic murmurs at apex with presystolic accentuation. Early diastolic of high amplitude and frequency at Erb's and aortic areas |
| Marked sinus arrhythmia and bradycardia. P waves wide and notched. QRS high. Tracing suggests combined mitral and aortic disease. No digitalis | Early systolic and diastolic murmur at apex with presystolic accentuation. Opening click of mitral valve. Diastolic of decrescendo type at Erb's and aortic areas |
| Regular sinus rhythm. Peculiar axis deviation. P waves wide and notched suggesting auricular enlargement | Systolic murmur of low amplitude and diastolic of median amplitude over apex with presystolic accentuation. Occasional opening click mitral valve |
| Regular sinus rhythm. P waves wide and notched. QRS high and notched. RT1 slightly depressed. T1 diphasic. Tracing suggests auricular enlargement with enlargement of both ventricles. No digitalis | Prolonged systolic and diastolic murmurs over Erb's point, apex and aortic area. Opening click of mitral valve over apex |
| Auricular fibrillation. Right axis deviation. Small R4. RT2,3 depressed. T1 low. T3 diphasic. Tracing suggests enlargement of the right ventricle. Patient received digitalis | Prolonged systolic and diastolic murmur over 5th intercostal space to the left parasternally. Opening click of mitral valve |
| Auricular fibrillation. Frequent premature ventricular beat. Right axis deviation. QRS high =0.11 sec. RT1,2 depressed. T2,3 inverted. Tracing suggests enlarged right ventricle. Digitalis given | Systolic and prolonged diastolic murmur over apex. Opening click mitral valve |
| Auricular fibrillation. Tendency to right axis deviation. QRS =0.10 sec. RT1,2,3 slightly depressed. T1 diphasic. T2,3 inverted. Tracing suggests enlarged right ventricle. Digitalis given | Systolic murmur and opening click of mitral valve at the apex followed by short diastolic murmur |

TABLE I—*Continued*

| Case No. | Clinical Diagnosis | Name | Sex | Age | First Attack Rheumatic Fever | Recurrence Rheumatic Fever | Heart Failure | Clinical Symptoms and Findings |
|---|---|---|---|---|---|---|---|---|
| 15 | Mitral stenosis and insufficiency; aortic insufficiency; tricuspid insufficiency | T.W. | F | 19 | ? | 18 yr. | 12 and 18 yr. | Innumerable admissions for heart failure for past 6 yr. Now admitted with marked orthopnea. Left recurrent paralysis. Marked hepatic enlargement |
| 16 | Mitral insufficiency | E.T. | M | 17 | Chorea at age of 16 | None | None | Asymptomatic. Blood pressure 138/82 |
| 17 | Mitral insufficiency | B.G. | M | 13 | ? | None | None | Asymptomatic. Murmur discovered accidentally |
| 18 | Mitral stenosis and insufficiency | J.A. | M | 15 | Chorea 2 mo. ago | None | None | Chorea for 2 mo. No history of epistaxis or joint pains |
| 19 | Mitral insufficiency | H.R. | M | 16 | 14 yr. | None | None | Asymptomatic |
| 20 | Mitral insufficiency | F.L. | M | 17 | ? 14 yr. | None | None | Otitis media, upper respiratory infection and inflammation of symphysis pubis at age of 14. Now asymptomatic |
| 21 | Mitral insufficiency | S.H. | M | 17 | ? | None | None | Frequent headaches. Occasional pain in right wrist. No cardiac symptoms |
| 22 | Aortic insufficiency; subacute bacterial endocarditis | B.Z. | M | 44 | 8 yr. | None | None | Valvular lesion discovered at age of 18. Subacute bacterial endocarditis (*Streptococcus viridans*) for 3 mo. |
| 23 | Mitral stenosis and insufficiency; aortic insufficiency | J.B. | M | 22 | ? | 11 yr. | 18 yr.; 22 yr. | Patient incapacitated for almost 3 yr. Marked systolic thrust in chest, neck and head. Liver 5 cm. below costal margin. No râles. Blood pressure 190/0? |
| 24 | Aortic stenosis and insufficiency; mitral stenosis and insufficiency | A.L. | M | 30 | ? | None | None | Epistaxis, dizziness. Otherwise asymptomatic on rest and phenobarbital. Blood pressure 104/62. Symptoms suggested neurocirculatory asthenia |
| 25 | Aortic stenosis and insufficiency; mitral stenosis and insufficiency | F.L. | F | 50 | ? | None | First attack 2 yr. ago | Onset of auricular fibrillation 1 yr. ago. Fever for 3 wk. |
| 26 | Aortic stenosis and insufficiency; mitral stenosis and insufficiency | Q.O. | M | 55 | ? | None | 50 yr.; 55 yr. | Murmur discovered 5 yr. ago. For 6 mo. increasing dyspnea with noctural paroxysms. Marked pulmonary edema. Enlarged liver |
| 27 | Mitral stenosis and insufficiency; tricuspid insufficiency; encapsulated pericarditis | F.M. | M | 45 | Arthritis at 31 yr. | ? | 37 yr.; 45 yr. | Engorged neck veins. Signs of right and left heart failure. Blood pressure 130/80. Venous pressure 8 cm. Saccharine time 33 sec. |
| 28 | Mitral stenosis and insufficiency; tricuspid insufficiency | M.B. | M | 25 | ? | None | None | Pleurisy with effusion at 15 when murmur was discovered. Normal activity until 3 yr. ago. Progressive dyspnea for past 6 mo. Palpation, edema, pulsating liver, systolic thrill at apex |

the left atrium with prolonged and intensified opacification. The middle segment of the left cardiac border could be divided, in the posteroanterior view, into an upper and lower arc except in one case. The cephalad arc was produced either by the main pul-

Table I—*Continued*

| Electrocardiogram | Phonocardiogram |
|---|---|
| Regular sinus rhythm. PR interval 0.30 sec., suggesting impairment conduction system. RT2,3 slightly depressed | Systolic and prediastolic murmur at apex with opening click. Decrescendo early diastolic murmur over Erb's area. Pulse tracing suggests tricuspid insufficiency |
| Wenckebach's periods. First degree heart block after atropine. PR =0.30 sec. Otherwise within normal variation. Tracing suggests impairment of conduction system | Early systolic murmur "bruit de cannon" whenever PR is short |
| Regular sinus rhythm. Peculiar axis deviation. Otherwise within normal limits | Systolic murmur at apex. Maximum in mid systole |
| Regular sinus rhythm. Peculiar axis deviation. Otherwise within normal limits | Systolic murmur at apex of low amplitude. Opening click of mitral valve |
| Regular sinus rhythm. No abnormality | Systolic murmur at apex. Maximum in mid systole |
| Regular sinus rhythm. P waves notched. QRS low in lead I. Within normal limits | Systolic murmur at apex of low amplitude. Physiological third heart sound present |
| Regular sinus rhythm. P waves notched. Within normal limits | Early systolic murmur at apex. Physiological auricular and third heart sound present |
| Regular sinus rhythm. Left axis deviation. QRS 0.10 sec. RT2 slightly depressed | Systolic murmur at the apex. Early diastolic murmur of high frequency. Maximum over Erb's point |
| Regular sinus rhythm. Peculiar axis deviation. PR=0.26 sec. P waves very wide and notched. QRS =0.11 sec. T1 isoelectric. Tracing suggests auricular enlargement with myocardial damage. Patient received digitalis | Systolic and prolonged diastolic murmur of high amplitude over apex, Erb's and aortic areas. Right carotid pulse tracing showed anacrotic notch and vibrations in systolic portion |
| Regular sinus rhythm. Peculiar axis deviation. QRS high. RT2,3 slightly depressed. T2 diphasic. T3 semi-inverted. Tracing suggests combined right and left ventricular enlargement. No digitalis | First sound split. Systolic and diastolic maximum over the aortic areas |
| Auricular fibrillation. QRS high. RT1,3 slightly depressed. T1,3 diphasic. Tracing suggests combined right and left ventricular enlargement. Digitalis given | Systolic and prolonged diastolic murmur at apex. Systolic and early diastolic of decrescendo type at Erb's area |
| Regular sinus rhythm. Left axis deviation. P waves wide and notched. QRS slurred, wide and notched. RT1,2 slightly depressed. T1,2 diphasic. Tracing suggests auricular and left ventricular enlargement and myocardial damage. Patient received digitalis | Systolic and diastolic murmurs at the apex. Systolic of very high amplitude at the aortic area. Pulse tracing over carotid artery showed a low rise, systolic vibration and steepness indicative of aortic stenosis and insufficiency |
| Auricular fibrillation. Right axis deviation. Small Q2,3. QRS notched. T2 low. T3 inverted. Tracing suggests enlarge right ventricle with myocardial damage. Patient received digitalis | Heart sounds distant. Faint systolic murmur over apex. Pulsations of liver synchronous with arterial pulsation |
| Regular sinus rhythm. Marked right axis deviation. PR =0.25 sec. P waves wide and notched. Tracing suggests aurciular and right ventricular enlargement | Systolic and early diastolic murmur at the apex with opening click of mitral valve. Systolic and early diastolic murmur in tricuspid areas. Pulse tracing suggests tricuspid insufficiency |

monary artery or by the left branch or both. The caudad arc was formed by the left auricle. In one case (Case 7) the entire middle segment was made up of the main pulmonary artery alone. The pulmonic conus was always found well within the car-

diac silhouette. In no instance did it contribute to the formation of the left cardiac border. The left atrium in every case formed the upper part of the right border.

The oblique views revealed that the enlarged left atrium displaces an elongated pulmonary artery anteriorly and cephalad producing the anterior bowing of these structures. The pulmonic conus and occasionally the entire right ventricle were displaced anteriorly. In this way also is explained the prominent anterior convexity of the mid left contour as it is visualized in the conventional right oblique position. In our cases, the pulmonary artery did not seem to be significantly dilated. Angiocardiography has established that the right ventricle does not enter into the cardiac contour. Certainly the prominence of the middle segment is not due to right ventricular enlargement primarily, but, as has been indicated, to left atrial enlargement with displacement and elongation of the pulmonary artery. The size of the right ventricle, therefore, cannot be estimated from the conventional roentgen examination. For purposes of comparison with the typical mitral configuration, the following groups also were studied:

*Giant Left Atrium.* Four cases of giant left atrium were examined (Cases 12–15). These presented no essential differences from the typical mitral configuration. In one instance, the giant left atrium extended far beyond the right atrium and formed the entire right border of the cardiac silhouette. In another instance, enlargement of the left atrium proceeded to the left rather than to the right and formed almost the entire left cardiac border.

*Mitral Insufficiency.* Six cases were studied in which the predominant lesion was mitral insufficiency (Cases 16–21). The cardiac configuration revealed a poorly defined small middle segment on the left border. The component parts, however, were the same as in typical mitral configuration. With a single exception, the left atrium showed insignificant enlargement.

*Aortic Configuration.* There were 5 cases of combined mitral and aortic disease which presented a typical aortic configuration (Cases 22–26). The middle segment of the left border was small and formed by the pulmonary artery or the left pulmonary artery or both. Below this, the left auricle occasionally approached the contour. In some instances, the enlarged left atrium participated in the formation of the right cardiac border.

*Tricuspid Configuration.* Two cases of triosteal disease (Cases 27–28) were studied. In both, the right ventricle was enormous but in neither did the pulmonic conus approach the cardiac border. The left middle segment was formed here, as in the other cases, by the pulmonary artery and mainly by the left auricle.

## CONCLUSIONS

Angiocardiography has permitted an analysis of the formation of the cardiac contour during life. The method has been applied to the analysis of the mitral configuration. The enlarged left atrium, which is a constant finding in mitral disease, is the most important factor in the production of this configuration. It forms a considerable portion of the right cardiac contour. In addition, the left auricle forms the lower arc of the middle left cardiac contour. The upper or cephalad arc is formed by the pulmonary artery or the left pulmonary artery or both. The pulmonary artery is elongated and displaced anteriorly and cephalad by the left atrium and usually is not significantly dilated. The right ventricle does not enter into the cardiac contour. Its size is not proportional to the prominence of the middle left segment which is, in fact, produced indirectly by the left atrium, displacing the pulmonary artery. The pulmonic conus is always found well within the cardiac silhouette and does not contribute to the formation of the left cardiac border.

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# NON-TUBERCULOUS PULMONARY CAVITATION

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EXPERIENCE has taught us that chronic pulmonary infiltrative lesions involving the upper lobes are predominantly tuberculous[2] and that when cavitation is present the diagnosis of tuberculosis is almost certain. In a hospital devoted almost exclusively to the care of tuberculosis, one would expect these criteria to be even more positive. Yet in an analysis of 2,000 autopsies at Sea View Hospital, on patients with cavitary lesions in the lungs, involving all lobes, Auerbach[1] has found approximately 1.5 per cent with non-tuberculous cavities. Since this percentage holds true at Sea View Hospital, it must be much greater in non-tuberculous or general hospital autopsy material.

FIG. 1. Case 1. Anthracosilicosis. Extensive infiltration bilaterally, with a large irregular cavity just below the left clavicle. A large cavity is also visible in the right mid lung field. Autopsy diagnosis: anthracosilicosis with cavitation ("phthisis negra"). No evidence of tuberculosis was found.

It is the purpose of this paper to illustrate, roentgenographically, lesions of the lung which presented cavitation or what simulated cavitation, particularly of the upper lobes, and which on biopsy or autopsy proved to be non-tuberculous. The majority of these patients were referred to Sea View Hospital from other metropolitan hospitals, with the diagnosis of tuberculosis made clinically, roentgenographically, and in one instance apparently by a positive sputum examination.

The following cases illustrate some of the pulmonary lesions which may present cavitation of the lung fields roentgenographically, thus simulating tuberculosis:

## REPORT OF CASES

CASE 1. C. S., white male, aged fifty-seven, with a twenty year history of hard coal mining and seven years' work with a jack hammer. Patient had a transient attack of asthma in 1925, about which very few details could be elicited. He was apparently well until 1936, when he entered Kings County Hospital because of cough, expectoration of black sputum, and dyspnea. Diagnosis on roentgen examination was chronic pulmonary tuberculosis; sputum was negative. He was discharged in December, 1936, but had a hemoptysis in July, 1937, and was readmitted to Kings County Hospital. He left the hospital after six weeks against advice.

Patient was admitted to Sea View Hospital on August 17, 1937, because of left chest pain and increasing dyspnea. Physical examination showed a chronically ill white male, markedly dyspneic, with slight cyanosis of the nail beds, barrel-shaped chest, diminished breath sounds throughout the chest with occasional moist râles in the left interscapular region.

Roentgenogram revealed a diffuse, bilateral, conglomerate infiltration with cavitation in the mid lung fields on both sides. There was evidence of a cavity with fluid level in the left upper lobe, just below the clavicle. Extensive emphysema was seen at both bases, with irregularity of the cusps of the diaphragm caused

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by adhesions. The trachea was deviated to the right side (Fig. 1).

The sputum and gastric examinations were persistently negative for tubercle bacilli and fungi. The sputum often contained black particles and was occasionally blood tinged. Patient expectorated about 2 ounces daily.

The hospital course was gradually retrogressive, with increasing dyspnea and marked wheezing. Patient died on December 6, 1937, apparently of respiratory failure.

*Autopsy.* The lungs showed anthracosilicosis of all lobes and multiple areas of cavitation involving the right upper, right lower, left upper and left lower lobes. There was no evidence of tuberculosis.

*Comment.* Schwartz and Auerbach[4] mention the fact that when, on the roentgenogram, cavitation is seen in a patient with a history of exposure to silica dust, there is a tendency to automatically make a diagnosis of silicotuberculosis rather than silicosis. This should never be done unless the sputum is positive for tubercle bacilli. "X-ray cavities in silicosis may be produced by emphysematous blebs, lung abscesses or necrosis of silicotic areas."

Case II. A. P., a female, aged forty-one, Puerto Rican, who was in comparatively good health until 1937, when she began to complain of cough, chills, fever, expectoration, and weight loss. She gave a history of having had influenza in 1921 and frequent upper respiratory infections since then.

Patient entered Bellevue Hospital the latter part of 1939, and a diagnosis of tuberculosis was made. She was placed on conservative therapy and was transferred to Sea View Hospital on September 3, 1940.

Admission roentgenogram at Sea View Hospital showed an enormous cyst in the upper half of the right lung, and numerous small cysts distributed throughout the remaining lower half of the lung. The right lung was shrunken and the right dome of the diaphragm was markedly elevated. The left lung showed no infiltration or consolidation and there was no evidence of any cavitation in the left lung (Fig. 2).

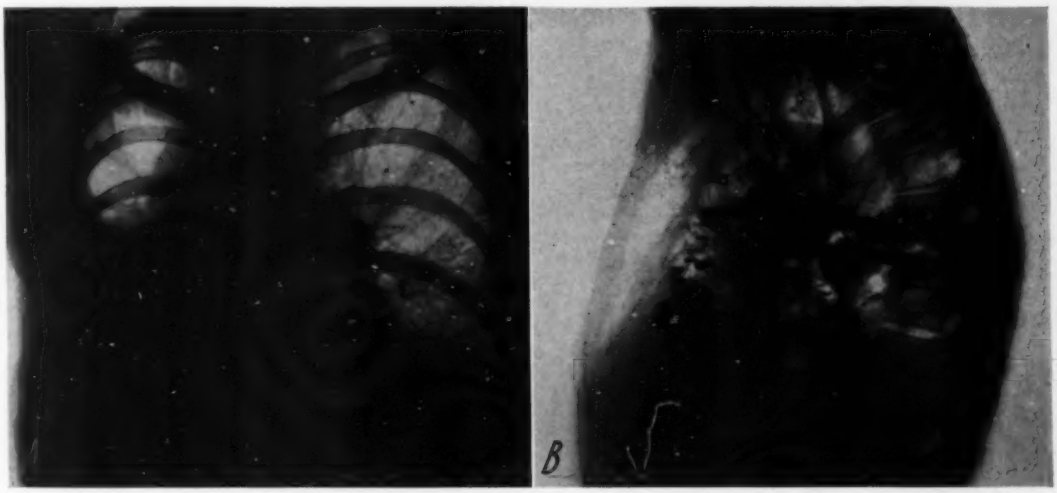


Fig. 2. Case II. Lung cyst. *A*, giant cyst in upper half of right lung field. Numerous smaller cavities are visible in right lower lung field. *B*, lateral view of right lung, following instillation of lipiodol. Huge cyst is visible in posterior portion of right upper lobe. Numerous bronchiectatic cavities are seen below the cyst. Lipiodol does not enter the cyst.

Examinations of the sputum for tubercle bacilli and fungi were persistently negative. Temperature ranged irregularly from 98° to 102° F.

Bronchographic examination showed multiple bronchiectatic cavities in the right lower and middle lobes. The lipiodol did not, however, enter the large cyst in the right upper lobe. The bronchi on the left side were normal. Bronchoscopy on December 4, 1940, showed a stenotic right main bronchus, and there was a soft, compressible mass, apparently rising from

FIG. 3. Case III. Actinomycosis. Bilateral patchy type of infiltration with several highlights suggesting cavitation. Sputum positive for actinomyces, negative for tubercle bacilli.

the right wall of the carina, occupying the right middle lobe bronchus. Purulent secretions were seen coming from the stenotic opening. Removal of the mass was considered inadvisable.

A right pneumonectomy was performed on July 8, 1941. The opinion of the pathologist (Dr. Auerbach), after examination of the lung removed at operation, was that the large cyst in the right upper lobe was bronchiectatic in origin rather than congenital. The final diagnosis, therefore, was cystic bronchiectasis.

*Comment.* The thin wall, devoid of surrounding inflammatory reaction, in addition to the negative sputum, is important in the diagnosis of a lung cyst. Lung cysts may contain a small amount of basal exudate. The orifice of the communication with the bronchus is often so small that lipiodol cannot be introduced into the cavity.[5]

CASE III. L. D., white male, aged fifty-one, with a past history of exposure to silica dust as a coal miner for a period of about fifteen months. He had pneumonia on the right side in 1928 and on the left side in 1934. Pain developed in the left chest in July, 1938. He was admitted to Coney Island Hospital in October, 1938, where a diagnosis of bilateral pulmonary tuberculosis was made.

Patient was transferred to Sea View Hospital, where roentgen examination showed an exudative productive type of infiltration in the upper half of both lung fields, with several small highlights suggestive of cavitation (Fig. 3). Although the patient expectorated a box of sputum daily, no tubercle bacilli were ever found.

Bronchoscopy on October 26, 1938, was negative except for some reddening of the orifice of the right upper lobe bronchus. Smears of the bronchial secretions were negative for tubercle bacilli and fungi. Another bronchoscopy was done on March 1, 1939, at which time actinomyces were found in the secretions of the right upper lobe.

A chest wall abscess developed on March 30, 1939, and the aspirated pus was positive for actinomyces. The mass gradually disappeared. In June, 1939, the patient's condition became rapidly worse. His temperature began to spike daily, he became progressively more dyspneic, and died on June 25, 1939.

*Autopsy.* Examination at autopsy showed multiple actinomycotic abscesses of the lung, involving the left upper lobe, left lower lobe, and right lower lobe. There was also a small tuberculous excavation of the right upper lobe.

*Comment.* Detection of fungi in the sputum is the only decisive method of diagnosis. Sante[3] speaks of two forms of the disease: "One, peribronchial infiltrations clustering about the bronchi of the hilum region and lower lobes; the other, forming large confluent granulating masses which ultimately break down, forming large abscess, or which extend to involve the pleural cavity, producing empyema."

CASE IV.* M. F., colored laborer, aged fifty-three, who was apparently well until May, 1939, when he noted increasing weakness, malaise, anorexia, weight loss and pain in the left chest radiating to the back. This was followed in a few weeks by a hemoptysis of 1,000 cc. of bright red blood. The patient entered a city hospital in June, 1939, where a roentgen examination of the chest revealed the presence of an extensive area of increased density in the left mid lung field, and a large cavity with a fluid level, measuring about 5 cm. in diameter, present in the infiltrated zone (Fig. 4, *A* and *B*). One sputum

* This case was originally reported in full by Dr. Harry L. Katz, in the *Quarterly Bulletin of Sea View Hospital* 1940, *6*, 79–91.

examination was reported positive for tubercle bacilli. In view of this, the diagnosis of pulmonary tuberculosis was made and pneumothorax was instituted on the left in July, 1939. The sputum continued to be blood streaked for several weeks, but repeated sputum examinations were negative at that time for tubercle bacilli. Roentgenograms following the institution of pneumothorax revealed a visible mass in the left mid lung field, with moderate collapse of the lung. The Wassermann reaction was positive. Past history was non-contributory. He denied a luetic primary or secondary lesion, and he had never received antiluetic therapy.

On November 15, 1939, patient was transferred to Sea View Hospital for further therapy. Physical examination at that time showed a well developed but poorly nourished colored male. There was a lag in the left hemithorax, percussion note was impaired, and there were diminished breath sounds in the left chest in the upper half, anteriorly and posteriorly. Cardiac examination was essentially negative. Sputum was negative for tubercle bacilli, and other laboratory findings were essentially negative.

A roentgenogram of the chest on November 17, 1939, revealed a rounded density, extending

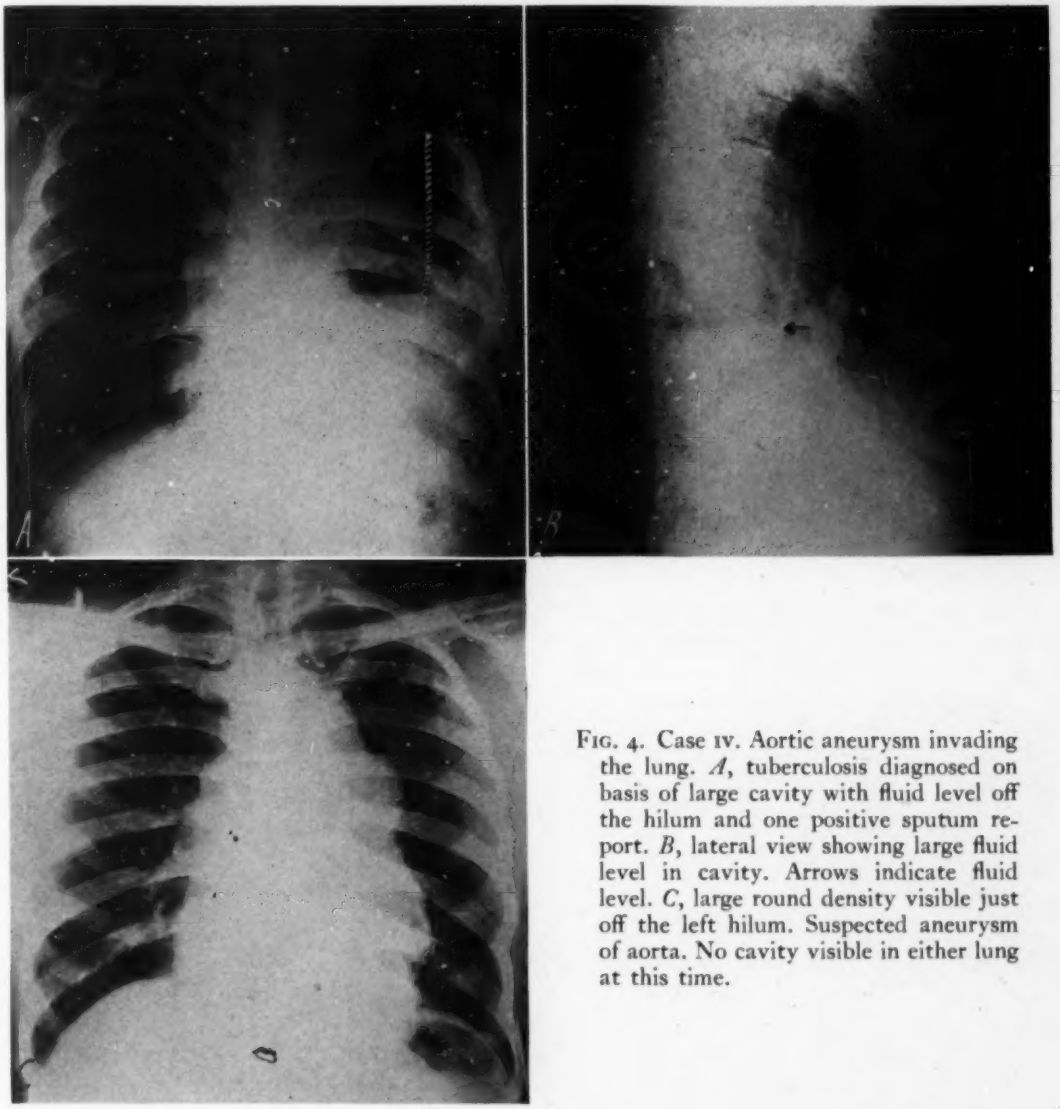


Fig. 4. Case IV. Aortic aneurysm invading the lung. *A*, tuberculosis diagnosed on basis of large cavity with fluid level off the hilum and one positive sputum report. *B*, lateral view showing large fluid level in cavity. Arrows indicate fluid level. *C*, large round density visible just off the left hilum. Suspected aneurysm of aorta. No cavity visible in either lung at this time.

laterally on the left side, fused with the shadow of the descending portion of the arch of the aorta, suggesting a localized aneurysm (Fig. 4, *C*). A roentgenogram of the spine showed no evidence of vertebral erosion. Bronchogram did not reveal narrowing or constriction of the left main bronchus by the aneurysm.

The patient received weekly pneumothorax refills of 100 to 150 cc. of air. On December 11, 1939, and again on December 13, 1939, he had hemoptyses of about 500 cc. of bright red blood. The sputum continued to be blood streaked for a considerable period of time and on January 24, 1940, he suffered a fatal hemoptysis of about 1,500 cc. of bright red blood.

*Autopsy.* It was found that there was a saccular aneurysm of the descending thoracic aorta which had invaded the left lower lobe and produced a large cavity, 5.5 cm. in diameter. There was no tuberculous involvement of either lung.

*Comment.* This case illustrates the danger of diagnosing pulmonary tuberculosis on a single positive sputum. A lung which shows a large cavity and yields persistently negative sputum after an initial positive should be suspected of disease other than tuberculosis.

CASE V. J. M., a white male, aged sixty, with a two months' history of weakness, weight loss, and cough productive of blood-streaked sputum. A roentgenogram of the chest showed a large cavity with basal fluid level in the left upper lobe (Fig. 5). The heart, trachea and mediastinum were shifted to the left, and the left leaf of the diaphragm was displaced upwards. Sputum examination was negative for tubercle bacilli.

Lipiodol studies showed obstruction of the left main bronchus. A biopsy obtained after bronchoscopy showed the presence of a bronchogenic adenocarcinoma of the lung.

*Comment.* In this case, the age of the patient, the brief duration of the symptoms, and the marked retraction of the heart and mediastinum with elevation of the diaphragm, serve to put us on guard against a diagnosis of tuberculosis. A chronic fibroid phthisis might give the same roentgenologic findings, but careful history would usually reveal a longer duration of symptoms than two months. Lipiodol frequently fails to enter cavernous neoplasms because the bronchus leading thereto is blocked by secretion, slough, pus or granu-

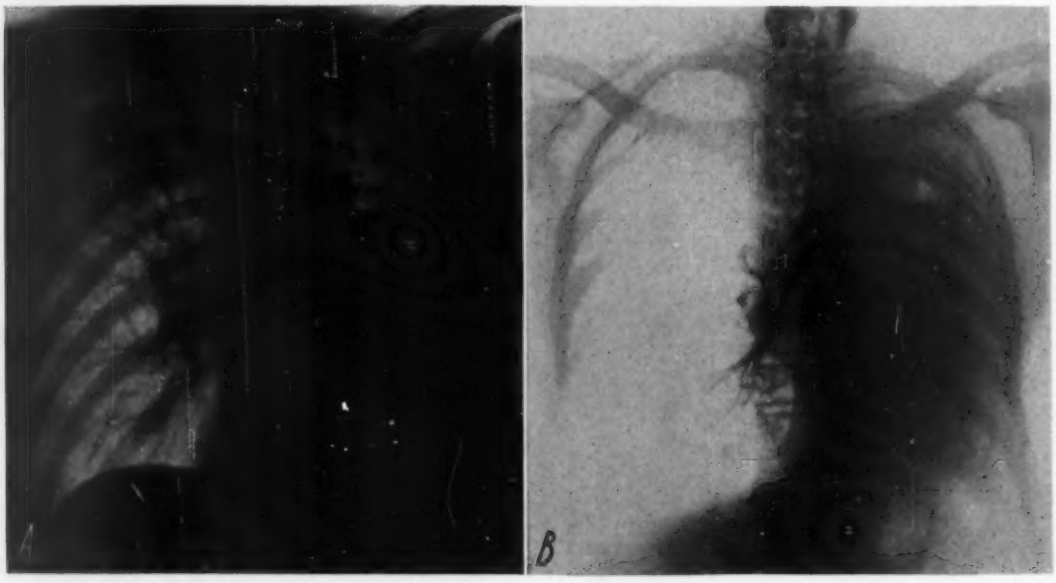


FIG. 5. Case v. Cavernous neoplasm. *A*, large cavity in left upper lobe, secondary to bronchogenic carcinoma. Heart and mediastinum are shifted to the left. *B*, bronchogram. Lipiodol is seen to stop abruptly at site of bronchial obstruction by carcinoma. Cavity with fluid level is seen in left upper lung field. Right bronchial tree is normal.

lation tissue, but the same is true of tuberculous or abscess cavities. The negative sputum and the biopsy were conclusive in making the diagnosis.

Case vi. A. T., Italian barber, aged fifty-six. His illness began in June, 1939, with a cough and expectoration which rapidly became profuse and foul. One month prior to onset, patient had several of his badly infected teeth extracted. A pain in the right upper chest was the first symptom noted. He was admitted to Greenpoint Hospital on June 17, 1940, with a chronic cough and profuse, foul sputum. A diagnosis of pulmonary abscess was made. Several bronchoscopies revealed pus from the right upper lobe. No tubercle bacilli were found in the sputum or gastric examinations.

Patient was transferred to Sea View Hospital on October 2, 1939. His general condition was fairly good. He expectorated 2½ cups of foul sputum daily, which was negative for tuberculosis but positive for streptococci, staphylococci, aerobes, anaerobes, fusiform bacilli, and spirochetes. A roentgenogram revealed a chronic lung abscess of the right upper lobe with a severe degree of surrounding bronchiectasis (Fig. 6). Bronchoscopy revealed thick, foul pus coming from the right upper lobe orifice. A pneumonotomy was done and the abscess drained, in one stage. A specimen of necrotic material was negative for neoplastic tissue.

Patient made an uneventful postoperative recovery. Sputum became scant and the odor disappeared. He gained 34 pounds in six months. The bronchocutaneous fistula slowly healed. A bronchogram on February 20, 1941, following the operation, showed residual bronchiectasis in the upper and mid lung fields on the right side. Patient's general condition was good and he was discharged on May 16, 1941.

*Comment.* Most lung abscesses are usually said to occur in the lower lobes. "The differentiation of a chronic lung abscess in an upper lobe from a tuberculous cavity may be very difficult, especially insofar as lung abscess, originally of pyogenic origin, may invade or reactivate an old tuberculous focus and even produce a positive sputum" (Sante). Repeated sputum examinations, however, will prove decisive in differentiation, since a tuberculous cavity of any size will persistently show many tubercle bacilli

Fig. 6. Case vi. Lung abscess. Abscess cavity in right upper lobe. Sputum persistently negative for tubercle bacilli. Good result following surgical drainage of abscess.

on plain smear, whereas a pyogenic abscess invading an old focus will show only a rare bacillus in the concentrate.

Case vii. B. D., an Italian chauffeur, aged forty-five, transferred to Sea View Hospital from Kings County Hospital on July 28, 1941. Past history includes several bullet wounds from the World War in 1917, and operation for peritonsillar abscess in 1931. In March, 1941, he developed cough, productive of foul sputum, fever, weight loss and weakness. There was no hemoptysis. He entered Kings County Hospital, where sputum was persistently negative for tubercle bacilli. Diagnosis was "lung abscess, right upper lobe." He had a moderate hemoptysis in June, 1941, with streaking lasting for several days.

Patient was transferred to Sea View Hospital on July 28, 1941, where roentgen examination showed large abscess cavities in the right upper lobe (Fig. 7). The blood sedimentation rate was 125 mm. in one hour. Sputum was negative for tubercle bacilli, but contained fusiform bacilli, gram-negative bacilli and streptococci. There were no Friedländer bacilli or fungi. Examination of the sputum for cancer cells was also negative.

Bronchoscopy on January 14, 1942, showed copious foul purulent discharge from the right main bronchus. There was no evidence of obstruction in the bronchial tree. Because of the

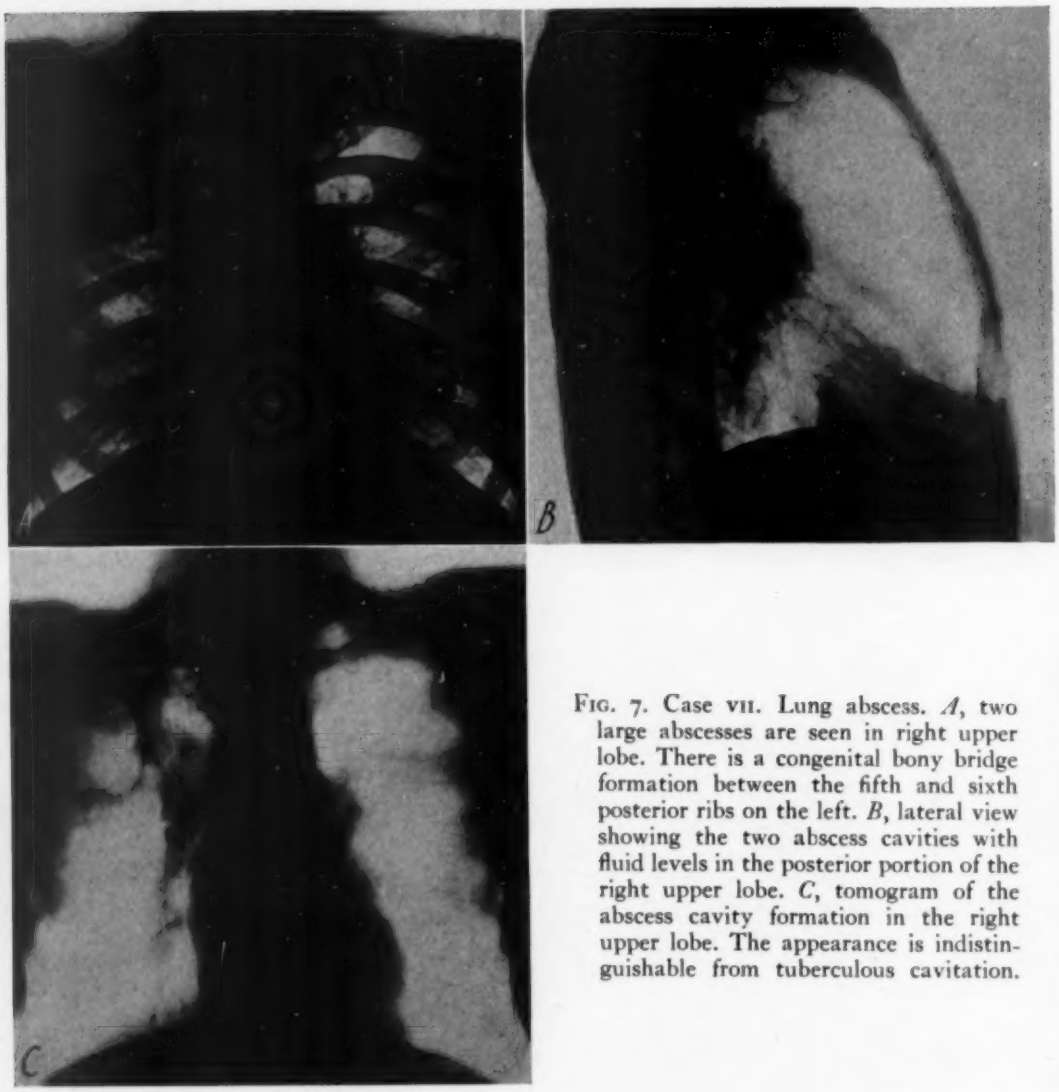

FIG. 7. Case VII. Lung abscess. *A*, two large abscesses are seen in right upper lobe. There is a congenital bony bridge formation between the fifth and sixth posterior ribs on the left. *B*, lateral view showing the two abscess cavities with fluid levels in the posterior portion of the right upper lobe. *C*, tomogram of the abscess cavity formation in the right upper lobe. The appearance is indistinguishable from tuberculous cavitation.

large size of the abscesses and their chronic character, it was the opinion of the surgical staff that pneumonotomy would not be of lasting value to this patient and that lobectomy, therefore, should be done. However, he improved somewhat on conservative therapy with postural drainage, and roentgen examination showed considerable decrease in the size of the abscess cavities. Patient ran a low grade temperature, with occasional rise to 101° F. In March, 1942, he left the hospital against advice.

*Comment.* In this case, there is no clear-cut etiology for the lung abscess and it is possible that we may be dealing with a chronic Friedländer bacillus infection. In a recent study of chronic Friedländer infections of the lungs, Solomon[6] found that the upper lobes were involved in 82 per cent of the cases and that lung abscess was the most frequent complication, occurring in 60 per cent of the cases. It is true that Friedländer bacilli were not found in the sputum in this case, but this is not conclusive. Solomon has pointed out that in the later stages of the disease, the organism is found mixed with or overgrown by secondary invaders.

Case VIII. M.H., a white male, aged sixty-two, with history of cough and frequent blood streaking for almost twenty-seven years. At the age of fourteen, in Austria, he had afternoon fever, chills and frequent colds for a period of three to four months. He received no medical attention. Following this, he was well until about 1915, when he was admitted to Bellevue Hospital because of cough productive of blood-streaked sputum. There a diagnosis of bronchiectasis was made. Sputum was negative for tubercle bacilli at that time and has been negative to date.

In June, 1941, patient had a hemoptysis of about 400 cc. He was admitted to Sea View Hospital on June 27, 1941. Roentgen examination showed multiple areas of cavitation in the left upper lobe and considerable deviation of the trachea and heart towards the left, with tenting of the diaphragm and emphysema at the left base. Repeated sputum and gastric examinations were negative for tubercle bacilli. Bronchogram showed extensive saccular and cylindrical bronchiectasis in the left upper lobe (Fig. 8). Patient was afebrile and symptom free except for some morning cough.

*Comment.* Sante speaks of the "isolated cavity" type of bronchiectasis most frequently encountered in the hilar region. "The traction of scar tissue on the bronchial walls in diffuse fibrosis may be the etiological factor in the production of bronchiectatic cavities." Clinically, a case of bronchiectasis involving the upper lobes is indistinguishable from chronic pulmonary tuberculosis. The physical signs, the pro-

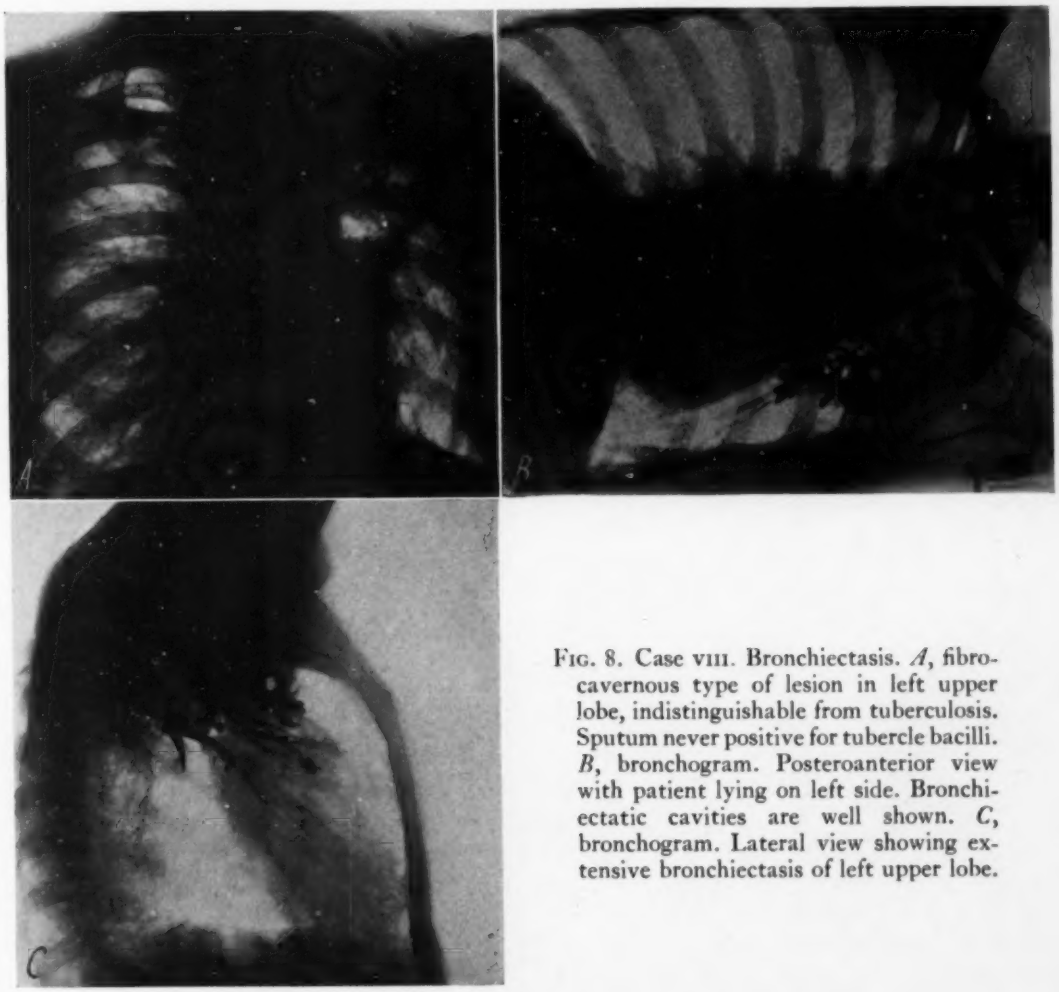

Fig. 8. Case VIII. Bronchiectasis. *A*, fibrocavernous type of lesion in left upper lobe, indistinguishable from tuberculosis. Sputum never positive for tubercle bacilli. *B*, bronchogram. Posteroanterior view with patient lying on left side. Bronchiectatic cavities are well shown. *C*, bronchogram. Lateral view showing extensive bronchiectasis of left upper lobe.

fuse expectoration, the occasional hemoptysis are the same in both. "In distinguishing these cases from tuberculosis," according to Wessler and Jaches,[7] "the absolute limitation of the process to one lung is of the greatest importance. While fibroid tuberculosis may be restricted to one lung, usually, if the case is of some duration the roentgen examination will disclose some infiltration in the opposite lung."

## CONCLUSIONS

Many pathological lung lesions will produce cavitation and simulate a cavitating tuberculous process. We have presented a series of cases from our material at Sea View Hospital illustrating some of these lesions. The majority of these patients were referred to our institution with a diagnosis of pulmonary tuberculosis, made clinically, roentgenographically and in one instance by a single positive sputum. The following chronic lesions are illustrated: anthracosilicosis, cystic disease of the lung, actinomycosis, aortic aneurysm producing pulmonary necrosis, bronchogenic neoplasm with parenchymal necrosis, a lung abscess of the upper lobe, cavitation probably as a result of Friedländer's bacillus infection of the lung, and a case of bronchiectatic cavitation of the upper lobe.

Other lesions will produce cavitation in the lung, and Winn[8] has recently reported twelve cases of pulmonary cavitation associated with coccidioidal infection. Slowly resolving nonspecific pneumonias may present areas of clearing that simulate cavitation and one may find cysts or bleb formation in association with pneumonias in children which will suggest a tuberculous lesion. Occasionally a gumma may cavitate centrally and simulate tuberculosis.

We must conclude, as others have done repeatedly before, that the roentgenographic diagnosis in itself is not conclusive, and that reports of series of this type are valuable in pointing out the possibility of other pulmonary lesions producing cavitation.

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# EMPHYSEMATOUS CHOLECYSTITIS*

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EMPHYSEMATOUS cholecystitis may be defined as an acute infection of the gallbladder characterized by gas production in the gallbladder lumen, walls, and pericholecystic tissues. Any virulent gas-producing organism may produce the disease when favorable local conditions exist.

Infection of the liver and biliary tract produced by gas-forming organisms has been recognized in many instances by surgeons and pathologists, but the roentgenologic demonstration of this condition is quite rare.

Hegner,[5] in 1931, reported what apparently was the first case in which it was possible to make a preoperative diagnosis of this condition by means of roentgenography. In fact, Hegner's case is the only one of its kind in the literature of this country, while Walters and Snell mention a similar case reported by Simon[11] in the French literature. Del Campo and Otero[2] of Uruguay have reported a case of emphysematous cholecystitis which was proved to be due to *B. welchii*.† Preoperative roentgenograms revealed gas in the biliary duct system, but a diagnosis of emphysematous cholecystitis was not made before surgical exploration. The infrequence of the roentgenographic diagnosis of emphysematous cholecystitis may be attributed primarily to the rarity of the disease itself and secondarily to the general lack of appreciation of the value of roentgenography in acute cholecystitis. Ramey and Scott[8] have shown that in a series of 110 cases of acute cholecystitis seen at the Scott and White Clinic from 1931 through 1940, roentgenographic examination of the gallbladder region, without any contrast medium, was of some value in the diagnosis of 40 per cent of the cases.

In the cases reported by Hegner[5] and by Koch,[7] organisms closely resembling *B. welchii* were demonstrated in material obtained from the acutely inflamed gallbladders. Andrews and Henry[1], as well as other investigators, have shown that *B. welchii* is frequently present in the bile and walls of both normal and diseased gallbladders. Of the various microorganisms which have been found in the gallbladder and its walls, *B. welchii* is the one most likely to produce gas under anaerobic conditions. It is not likely that *E. coli* can produce gas in the gallbladder walls because of the lack of air or oxygen in this location.

Ramey and Scott, Walters and Snell, and other authors, believe that the first step in the development of acute cholecystitis is the lodging of a stone in the cystic duct. Their conclusions are based on the fact that from 75 to 96 per cent of gallbladders removed during the subsiding stages of acute cholecystitis will have stones in the lumen while almost 50 per cent will show a stone firmly wedged in the cystic duct. The most probable sequence of events in the production of emphysematous cholecystitis is: (*a*) lodging of a stone in the cystic duct; (*b*) resulting decrease in the local resistance of the gallbladder tissues allowing the avirulent *B. welchii* to become virulent; (*c*) increased dosage of the gas bacilli in the bile and gallbladder wall; (*d*) production of gas in the gallbladder, emphysematous blebs in the loose areolar connective tissue of the gallbladder wall, and extension of the infection to the pericholecystic tissues.

Emphysematous cholecystitis differs from other acute infections of the gallbladder in that the disease cannot be specifically identified by clinical examination but has a typical roentgenologic appearance. According to Walters and Snell, the disease terminates fatally as a rule.

† Now termed *Clostridium perfringens*, but will be referred to throughout this paper as *B. welchii*

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FIG. 1. Case 1. Gas in the gallbladder lumen. Uniform ring of gas in gallbladder wall and small irregular blebs just outside this ring of gas.

FIG. 2. Case 1. This lateral view shows the gaseous mass to be in the anterior half of the abdomen. The shape of a large gallbladder is easily recognized.

Three cases having roentgenologic findings similar to the case reported by Hegner are given here in brief.

## REPORT OF CASES

CASE 1. J. A., male, aged sixty-four, was admitted to the University of Pennsylvania Hospital with a chief complaint of pain in the abdomen. The patient stated that he had known he had diabetes for the past fourteen years. In regard to his present illness, the patient said that eight days prior to entry into the hospital he noted some epigastric discomfort. Two days after that he began to have a dull pain in the right upper quadrant of his abdomen. The pain persisted, became more severe, and radiated to his right shoulder. On admission to the hospital it was evident that the patient, a well developed man, was acutely ill. Moderate jaundice of the sclera was discernible. A questionable mass was palpated in the right upper quadrant of the abdomen and there was moderate rigidity of the abdominal wall in this region.

Laboratory studies showed a leukocyte count of 13,000 with 86 per cent polymorphonuclear cells. Blood sugar analysis showed 190 mg. per 100 cc. The patient's temperature was 100.5°F.

A clinical diagnosis of acute cholecystitis, empyema of the gallbladder and diabetes mellitus was made. Roentgenologic investigation led to a diagnosis of emphysematous cholecystitis.

Figures 1, 2, 3, and 4 show the important findings.

The patient was operated on, and as soon as the omentum was opened a considerable quantity of cloudy fluid poured into the wound.

FIG. 3. Case 1. Patient erect. Note the intraluminal fluid level, gas above the fluid and gas in the gallbladder wall.

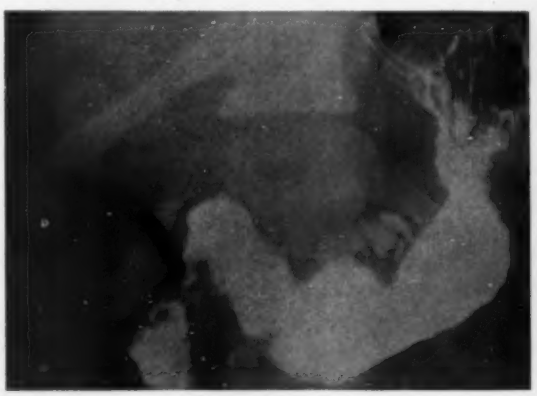

FIG. 4. Case 1. The duodenum is compressed by the large gallbladder.

After aspiration of this fluid, a completely gangrenous gallbladder, surrounded by a zone of gas, was found. A cholecystostomy was performed, and a large number of stones were evacuated from the gallbladder. Cultures were made of the peritoneal fluid only and showed aerobic and anaerobic streptococci, but no gas-producing organisms were found. The patient made an uneventful recovery and is now alive and well.

Case 11. W. R., male, aged sixty-three, was admitted to a St. Louis hospital with a chief complaint of pain in the right side of the abdomen. Two days prior to his admission to the hospital the patient began to have a persistent dull pain in the epigastrium. The pain increased in severity and the next day it was localized in the right upper quadrant of the abdomen. Physical examination showed an elderly, obese man who was apparently acutely ill. No masses were palpable in the abdomen, but there was marked tenderness and rigidity in the right upper quadrant.

The patient's temperature was 102°F. and a leukocyte count showed a total of 26,250. A clinical diagnosis of acute cholecystitis was made but because of the patient's age, obesity, and poor general condition, he was treated symptomatically. The patient improved slightly over a five day period and on the sixth day a roentgenogram of the gallbladder region, without any opaque medium, showed a large gallbladder distended with gas, as is shown in Figure 5. Another roentgenogram made two days later showed that the gaseous outline of the gallbladder was lost and in its place was an irregular collection of emphysematous blebs surrounded by a gas-filled, distended loop of small intestine (Fig. 6).

Fig. 5. Case 11. Gas in the gallbladder lumen, walls, and pericholecystic tissues.

Fig. 6. Case 11. The gaseous outline of the gall bladder wall is now lost. This is interpreted as meaning rupture of the gallbladder. A gas-filled loop of small bowel has surrounded the mass in an attempt to wall off the infection.

Fever and leukocytosis continued and gradually a large mass became palpable in the right upper quadrant of the patient's abdomen. On the eleventh day of hospitalization the patient was operated on. As soon as the peritoneum was opened there was a definite hiss of escaping gas. Large quantities of green pus welled up into the wound and about 400 cc. were removed by suction. A completely gangrenous gall-

FIG. 7. Case III. Note the similarity of this gas-filled gallbladder to those of Cases I and II.

bladder was lifted out of the abdomen. There was a single stone, about 1.5 cm. in diameter, firmly lodged in the neck, and one wall of the gallbladder had perforated. Routine cultures of the peritoneal pus showed no bacterial growth. No studies were done for possible anaerobic organisms.

Except for a mild bronchopneumonia, the patient made an uneventful recovery and was discharged from the hospital on the twenty-second postoperative day. He is now alive and well.

CASE III. W. W., male, aged fifty-two, was admitted to the Scott and White Clinic with a chief complaint of pain in the abdomen. For the preceding five years the patient had had occasional attacks of anorexia, intolerance to fried and greasy foods, and discomfort in the right upper part of the abdomen. Five days prior to admission to the clinic, the patient experienced a sudden severe pain in the epigastrium and right upper part of the abdomen. The pain persisted and soon nausea and vomiting developed. In spite of symptomatic treatment the patient steadily became worse.

Physical examination showed a well developed, slightly obese man who was apparently acutely ill. A moderate icteric tint of the skin

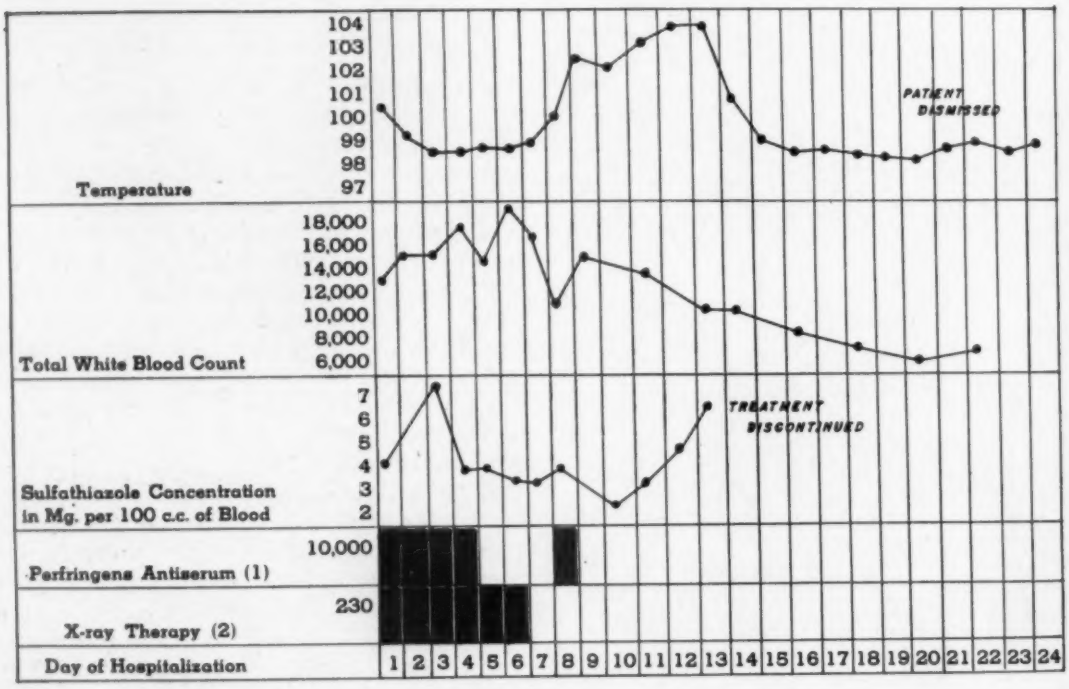


FIG. 8. Case III. This graph shows the relationship between the medical treatment and the patient's temperature and total white blood count.

Fig. 10. Case III. Third day. Note large, emphysematous bleb superimposed on the gallbladder shadow.

was noticed and a tender mass about 10 cm. in diameter was palpable in the gallbladder region. The patient's temperature was 100.5°F., and the total leukocyte count was 13,000.

A clinical diagnosis of acute cholecystitis was made, and a roentgenogram made on the

Fig. 9. Case III. Second day of hospitalization. Note increase of gas in gallbladder wall.

day of admission to the clinic led to a diagnosis of emphysematous cholecystitis (Fig. 7).

Recognizing the work of Kelly and Dowell[6] in the use of roentgen therapy for gas gangrene, the well known value of specific antiserum in gas gangrene, and the possibility of favorable action of sulfathiazole,[4] a combination of all these therapeutic agents was used in the treatment of this patient.

Fig. 11. Case III. Fourth day. Slight decrease in amount of gas in gallbladder wall.

FIG. 12. Case III. Definite decrease in amount of gas in the wall on the fifth day.

Figure 8 is a composite graph showing the relationship of the treatment to the patient's temperature and total leukocyte count.

Serial roentgenograms showed a definite correlation between the amount and extent of the gas in and around the gallbladder to the patient's general condition (Fig. 9–16).

FIG. 14. Case III. Eleventh day. Decrease of gas in all areas.

After six days of this medical treatment the patient improved markedly. A sudden rise in temperature after this improvement was thought to be due to either a late serum reaction or excess sulfathiazole concentration in the blood. The temperature promptly returned to normal when the sulfathiazole was discontinued. The patient was dismissed from the hospital on the twenty-fourth day.

FIG. 13. Case III. Eighth day. Marked decrease in the gas in the gallbladder lumen.

The patient has been seen recently and is now in excellent health. Roentgenographic examination of the gallbladder, after administration of the radiopaque dye, showed no evidence of concentration of the dye, no radiopaque stones and no abnormal gas shadows. Roentgenologic investigation of the stomach, duodenum, and colon showed no abnormal findings.

## SUMMARY

Cases I and II were proved to be emphysematous cholecystitis but unfortunately no intensive effort to demonstrate *B. welchii* was made. Case III had identical roentgenologic findings but since the medical treatment was successful, no proof was obtained.

All three cases showed gas in the gallbladder, blebs in the wall, and collections of gas in the pericholecystic tissues. No gas was noted within the biliary duct system. These findings are identical to the roentgenograms of the case reported by Hegner.

FIG. 15. Case III. Sixteenth day. Only a few small blebs remain. Patient clinically well at this time.

FIG. 16. Case III. Twentieth day. Three blebs remain. Patient was dismissed from the hospital four days after this roentgenogram was made.

There was no evidence of gas gangrene elsewhere in any of the four patients. The presence of gas in the gallbladder lumen alone is not sufficient for the diagnosis of emphysematous cholecystitis for cases of biliary fistulae commonly show gas in the gallbladder either with or without gas in the biliary duct system.[12]

It is interesting to note that Hegner's patient and the three patients described here were men, whose average age was sixty-three years in those operated on, while the patient receiving medical treatment alone was fifty-two years old. In the cases surgically proved, no patient gave a history suggesting previous gallbladder disease while the patient receiving medical treatment evidently had intermittent attacks of cholecystitis for about five years.

The previous idea that emphysematous cholecystitis is invariably fatal is disputed

by the fact that the three patients described here are now alive and well.

I am greatly indebted to Dr. E. P. Pendergrass, Professor of Radiology at the University of Pennsylvania, for his kindness in furnishing the history and roentgenograms of Case 1 as presented in this paper.

Dr. H. R. Senturia of St. Louis, Missouri, is due credit and appreciation for furnishing the history and roentgenograms of Case II.

## CONCLUSIONS

1. Three cases of emphysematous cholecystitis are added to the literature.

2. All three cases had similar roentgenologic findings and two of the cases were correctly diagnosed preoperatively.

3. Medical treatment consisting of sulfathiazole, *B. welchii* antiserum and roentgen therapy was successful in the treatment of one case.

4. Roentgenograms of the gallbladder region are of distinct value in cases of acute cholecystitis. The roentgenographic demonstration of gas in the gallbladder lumen, emphysematous blebs in the gallbladder wall, and collections of gas in the pericholecystic tissues is indicative of acute gangrenous cholecystitis, most likely caused by *B. welchii*.

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# ROENTGEN THERAPY FOR BRONCHIOGENIC CANCER*

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ROENTGEN therapy in bronchiogenic cancer is a universally accepted procedure of treatment. The result is palliation and these benefits are widely acknowledged. There is considerable variance of opinion as to whether life is actually prolonged by irradiation.

This investigation, therefore, has been an attempt to estimate the longevity cycle as well as correlate the factors of dosage which might be shown to have some relationship to the more favorable results in a series of 167 cases of bronchiogenic cancer receiving irradiation. The longevity cycle of irradiated cases was compared with another series of 119 cases which received no treatment. These were all microscopically proved cases. Autopsy confirmation was obtained in 53 per cent of the entire group. The roentgenologic interpretation was approximately 65 per cent correct. Bronchoscopic examination was by far the most important diagnostic procedure.

A review of the literature indicates that the incidence of primary bronchiogenic cancer has risen at an accelerating rate, being about 10 per cent of all cancers. This frequency is comparable to cancer of the large intestine. The present knowledge of the nature and consequences, as well as statistical analyses of the incidence, pathologic classifications and concomitant symptoms, is discussed in detail in the splendid monograph by Simons,[18] the symposium by Halpert,[7] and many other contributions, notably by Ochsner and DeBakey,[13] Jaffé,[9] Dublin,[4] Menne and Anderson,[12] and Matz.[11] Our own findings are essentially in accord with these other studies.

Lymph node biopsy was done in 7 cases. Pleural effusion revealed cancer cells in 19 instances. Lobectomy was done in 2 cases and surgical explorations in 3 cases. Roentgenologic investigations for skeletal metastases were not done routinely, except in cases where there was a clinical suspicion of such involvement. There were 11 cases with metastasis to the spine. Rib erosion was relatively common as seen in routine chest examinations in late cases.

The distribution of bronchiogenic cancer (100 cases) was as follows: in the right lung, main bronchus, 22 per cent; upper lobe, 27 per cent, and lower lobe 9 per cent; in the left lung, main bronchus, 19 per cent; upper lobe 15 per cent, and lower lobe 8 per cent. Until the development of surgical techniques, as well as experiences conclusively demonstrating a possible curability by radical surgical removal, the treatment of primary cancer of the lung has been regarded as a radiologic procedure. Unfortunately, the majority of the cases are advanced and inoperable when a clinical, roentgenologic or bronchoscopic diagnosis is made. There are, likewise, many patients who are already too ill for any kind of treatment when the diagnosis is made. It is obvious why it is so important to continue on with irradiation procedures in the vast majority of cases, because the only alternative would be to do nothing.

The roentgenologic criteria of operability are not always accurate, except for the circumscribed or peripherally located tumors. These types also offer diagnostic difficulties, particularly for bronchoscopic procedures. Our own experience with aspiration of tissue for microscopic study has been discouraging. The possibilities of metastatic cancer, cysts, neurofibroma, fibrosarcoma, hilar and mediastinal lymph node tuberculosis, aneurysm, empyema and lymphoblastoma, as well as other pathologic entities must be considered.

Explorations for diagnosis or surgical re-

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moval may be an ideal procedure but permission for such intervention is not always obtainable nor does the physical condition always permit such an approach.

Graham, Singer and Ballon[5] conclude that irradiation does not prolong the lives of patients with cancer of the lung because the great majority of the tumors are radioresistant.

Overholt and Rumel[16] studied the life expectancy of inoperable cases and found, on the average, that the patients who received high voltage roentgen therapy lived only two-thirds as long as untreated patients. Overholt[15] believes radiotherapy shortens the life of patients with cancer of the lung.

Portmann[17] believes that irradiation may afford symptomatic relief but does not prolong life. Craver, on the basis of 178 cases, reports that radiation therapy not only showed symptomatic relief but also prolonged life.

Alexander[1] feels that the only proper use of high voltage roentgen therapy is as a therapeutic test for possible lymphoblastoma and for palliation in inoperable, malignant neoplasms. He believes[2] that the use of roentgen therapy for other purposes is useless and may even be dangerous, because of the loss of valuable time, except for palliation in inoperable cases.

Steiner[19] did not find that survival was notably prolonged by irradiation; 21 irradiated patients survived for an average of 11.9 months after the onset of symptoms, as compared to 10.5 months in 53 control patients.

Leddy and Moersch[10] reported 25 of 125 patients alive one year or more after treatment; 3 were alive 119, 127 and 146 months respectively after starting treatment. Of 125 untreated patients none survived longer than one year. Since 25 patients who were treated lived from one to twelve years, the absolute value of roentgen therapy as a palliative measure for bronchiogenic cancer was regarded as self evident. Leddy and Moersch regard some of these results as so-called cures.

Tenzel[20] found that the survival period of irradiated patients was on an average five months longer than that of patients not so treated. The average duration of life from the onset of symptoms to death for the irradiated patients was fifteen months, and for those not given irradiation only ten months. Twice as many irradiated as non-irradiated patients survived more than one year.

Goldman[6] reported data on 11 patients with epidermoid carcinoma in which the duration of life was two years or more. Two of these were irradiated and were still alive 84 and 244 months after onset of symptoms but lived only 24 and 4 months respectively after the diagnosis was established. Nine patients lived 28, 30, 53, 61, 75, 98, 120, 151 and 168 months without any kind of treatment. Of these 9 patients, 2 did not live a month after the diagnosis was made; 2 lived one month; 1 lived three months; 1 lived four months and three lived 7, 11 and 12 months respectively.

It is a problem to decide when the malignant process actually started. The manifold variety of symptoms of cough, pain, dyspnea, etc., the unusually long duration of years in many instances by comparison with the very short duration of days or weeks in other cases creates a situation of considerable confusion and uncertainty when evaluating the life cycle of a bronchiogenic cancer. Results are poor because of the advanced stage of the disease at which a correct diagnosis is made in the majority of cases.

It is important and interesting to point out that many cases were clinically and roentgenologically regarded as primary cancer of the lungs, and found at autopsy to be Hodgkin's disease, lymphosarcoma, neurofibroma, tuberculosis and particularly metastatic cancer (Table 1). The sulcus tumors of Pancoast are considered here to be of bronchiogenic character.

There is no uniformity of opinion as to the histopathologic classifications of bronchiogenic cancer. The confusion seems to arise in proportion to the degree of ana-

plasia. The microscopic report was "carcinoma" in 37 per cent of the cases; squamous cell carcinoma in 28 per cent; adenocarcinoma in 24 per cent of cases; 11 per cent of the group were the so-called basal or reserve cell, round cell, spindle or oat-shaped cell types.

Steiner studied the microscopic effects of roentgen therapy on primary cancer of the lung, and in 21 cases irradiation of the tumor with doses up to 5,000 r did not destroy the cancer as judged by microscopic standards.

Difficulties of diagnosis exist even with the aid of bronchoscopy and comparative roentgenograms. Unresolved pneumonia, persistent suppuration or any indeterminate roentgenologic appearance should be considered as a possibly malignant neoplasm until proved otherwise. A peripherally located tumor may be slow growing and when symptoms develop the growth may be shown roentgenologically to involve an entire lobe. Cancer complicated by infection may result in many confusing roentgenologic appearances, and these changes vary widely according to the duration of the disease. Holman and Pierson[8] reported convincing evidence of cancer of the lung simulating roentgenologic effects of inflammatory disease. At certain stages in the development of pulmonary cancer there may be complicating infection with resulting characteristics of an intrapulmonary abscess, of purulent bronchitis, of bronchiectasis or even of tuberculosis.

Menne and Anderson[12] describe two macroscopic types. One, in which the major lesions, at least in the less advanced stages, seemed to be that of maximum hilar accumulation, the hilar nodular type; another, in which there was a diffuse involvement with a minimum of hilar concentration was termed the diffuse, necrotic type.

Olds and Kirklin[14] believe that abnormal, unilateral, hilar infiltrations are sufficiently constant to be regarded as almost pathognomonic, roentgenologic evidence of bronchiogenic cancer. This interpretation is in accordance with the results of this study.

TABLE I

AUTOPSY FINDINGS IN CASES ROENTGENOLOGICALLY CONSIDERED AS BRONCHIOGENIC CANCER (NOT INCLUDED IN THIS SERIES)

| | No. of Cases |
|---|---|
| 1. Metastatic Cancer Arising in: | |
| (a) Brain | 1 |
| (b) Esophagus | 2 |
| (c) Kidney | 1 |
| (d) Rectum | 1 |
| (e) Prostate | 1 |
| (f) Breast | 3 |
| 2. Mediastinal Tumor: | |
| (a) Lymphosarcoma | 4 |
| (b) Hodgkin's disease | 3 |
| (c) Neurogenic tumor | 2 |

Atelectasis was also noted frequently, and varied according to the stage of the disease when investigations were instituted. Pleural effusion occurred in 57 cases. Lung abscess, bronchiectasis and tuberculosis were frequent complications revealed at autopsy.

The technical procedures of irradiation varied considerably. A voltage of 200 kv. was the same throughout. The filtration was almost always 0.5 mm. of copper, but in some cases 2 mm. of copper was used. The target skin distance was uniformly 50 cm. Treatments were usually given every second day. Two, three and four fields of entry were irradiated on the same day. In a few cases cross fire technique was used with four fields anteriorly and four fields posteriorly. The majority of the cases were treated with one field directed through the anterior chest, and one field through the posterior chest. Various sizes of fields were used, as follows: 6 by 8 cm., 10 by 10 cm., 15 by 20 cm., and 20 by 20 cm.

The dose never exceeded 200 r given to each of two, three, four and occasionally more fields on the same day at the rate of three treatments each week. In some instances daily treatment was given according to the "Coutard method." The total doses are shown in Chart 1 as tissue doses (r) at the approximate tumor level, and the total on the skin varied according to the size of the field and the thickness of the individual.

The tissue dose at the approximate tumor level was 2,500 r in the majority of cases. The predetermined plan of dosage was usually 3,500 r, but treatments frequently were discontinued because of failing health and strength. All doses that were less than 2,500 r were treatments discontinued because of progressive weakness.

More than half of the treated cases received in excess of 2,500 r. This experience

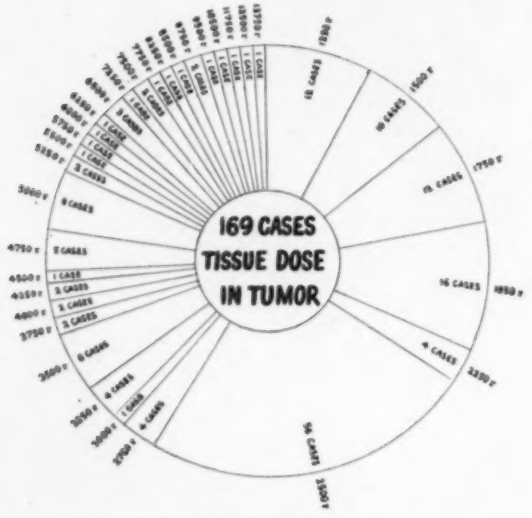


Chart I

revealed that the skin and physical tolerance may permit total doses of 8,000 r, 10,000 r, and 12,000 r. Any treatment that exceeded 2,500 r represented the total dosage of two, three or four series given at six, eight and twelve week intervals. In a small number of cases serial roentgenograms showed undoubted evidence of complicating, irradiation fibrosis, even after a single series of 2,000 r. These changes have been discussed by me elsewhere,[21] and are regarded as an effect of the underlying cancer and sometimes complicating infection.

Intrabronchial insertion of radon in gold seeds was done in 2 cases. Thoracotomy with direct insertion of radium into the peripherally located tumors has not been done in this series of cases. Radium packs were used in 9 cases. The dosage ranged from 5,000 to 30,000 millicurie-hours.

The problem of determining the longevity cycle is not simple. Histories were often vague as to the onset of the first symptom. In the majority of instances this evidence seemed clear, but the latitude ranged from a few days to several years or more. The average duration of symptoms in 114 cases where the case histories seemed to be very definite was 8.9 months. There were 2 cases with a history of cough extending over a period of twenty years. Eleven cases had some symptoms longer than three years.

Cancer of the lung was frequently an accidental finding when investigations were instituted to determine vague symptoms of fatigue, loss of weight, general indisposition and sometimes gastrointestinal complaints. Frequently the pulmonary infiltration was extensive when the study was made within a few days or few weeks after the first symptom of cough, blood, dyspnea or pain.

It is very obvious that it would be difficult and almost impossible to establish any criteria of longevity on the basis of correlating symptoms with the onset of the disease, because such evidence would automatically show that some patients, at least in this group of cases, would have lived more than five and ten years without any kind of treatment. Chronic lung infection is undoubtedly coincidental and referable symptoms may subsequently dovetail into the development of a malignant neoplasm.

It seemed necessary, therefore, to establish some uniform basis of calculating or estimating the benefit of radiation treatment by some other method. If the value of irradiation could be considered according to the duration of life from the time of making the diagnosis and instituting treatment, then a fixed routine and a definite standard plan for making comparisons and relative estimations would be greatly simplified. This would be an absolute factor and would permit some practical conclusion in a large group of cases.

In this study, therefore, the value of irradiation was considered according to the life cycle from the time of instituting roentgen treatment, and this was practically

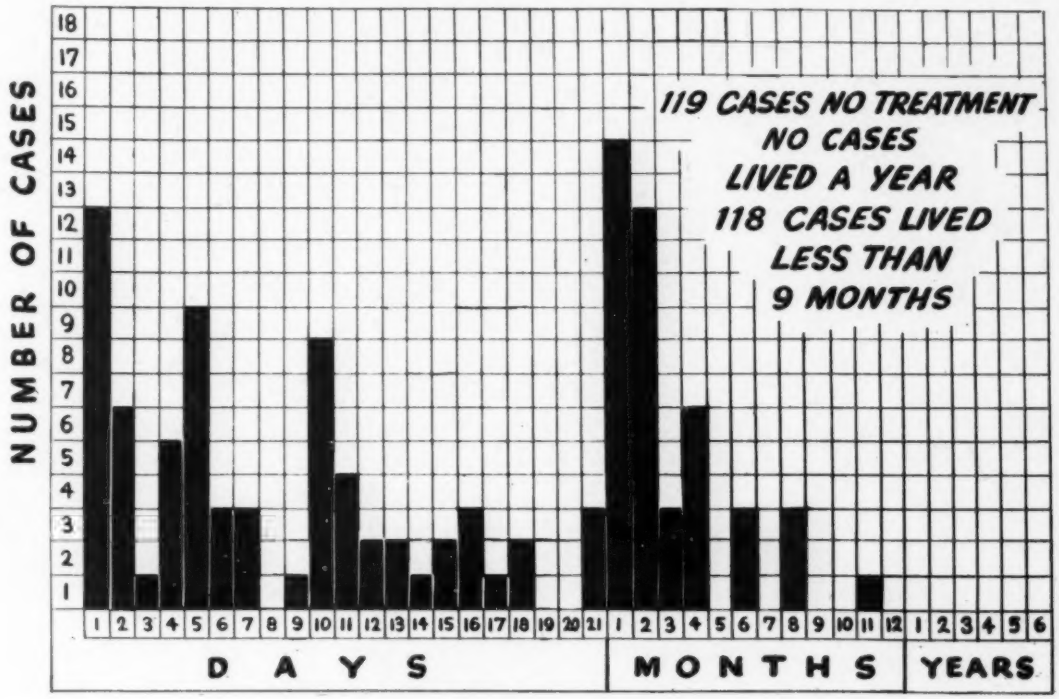


Chart II

always within a few days of making the diagnosis. A histopathologic study was sometimes not obtained until autopsy, but in these cases treatment was instituted on the clinical and roentgenologic evidence. This method definitely establishes a space of time which is accurate for all cases. Obviously the unknown duration and the varied extent of involvement before making the diagnosis precludes any possibility of a mathematical tabulation of the life expectancy of a given case.

The average of these variable factors in a large series of cases probably equalizes the pathologic status of a large number of cases when irradiation is started. The life cycle after irradiation is easily established. Any significant duration of time is obvious and beneficial effects can be reasonably determined. Conclusions cannot be absolute but relative estimations are simplified.

The 119 untreated cases are tabulated in Chart II. No case lived as long as one year after the diagnosis was made; 112, or 94 per cent, lived less than six months.

Some of these patients on admission were too ill for any kind of treatment to be considered. On the other hand, many were comparable with the clinical and physical status of the treated group but received no treatment at a time when they were all regarded as hopeless, before there was any interest in irradiation or before technical experiences with irradiation were developed. It would, therefore, be futile to make direct comparisons with the treated and untreated cases, but there is a relationship which must be given some consideration, and can readily be visualized by comparison of Charts II and III.

Of the 167 treated cases, 18 lived twelve months or more from the time of making the diagnosis (Chart III). Five cases lived two to six years as follows: 2 cases lived two years; 1 lived three years; 1 lived five years and 1 is still alive six years. The patient still alive six years was forty-three years of age when treatment was started. He now has a persistent, dry cough, which may be due to irradiation fibrosis or cancer or both. Repeated bronchoscopic examinations have been negative.

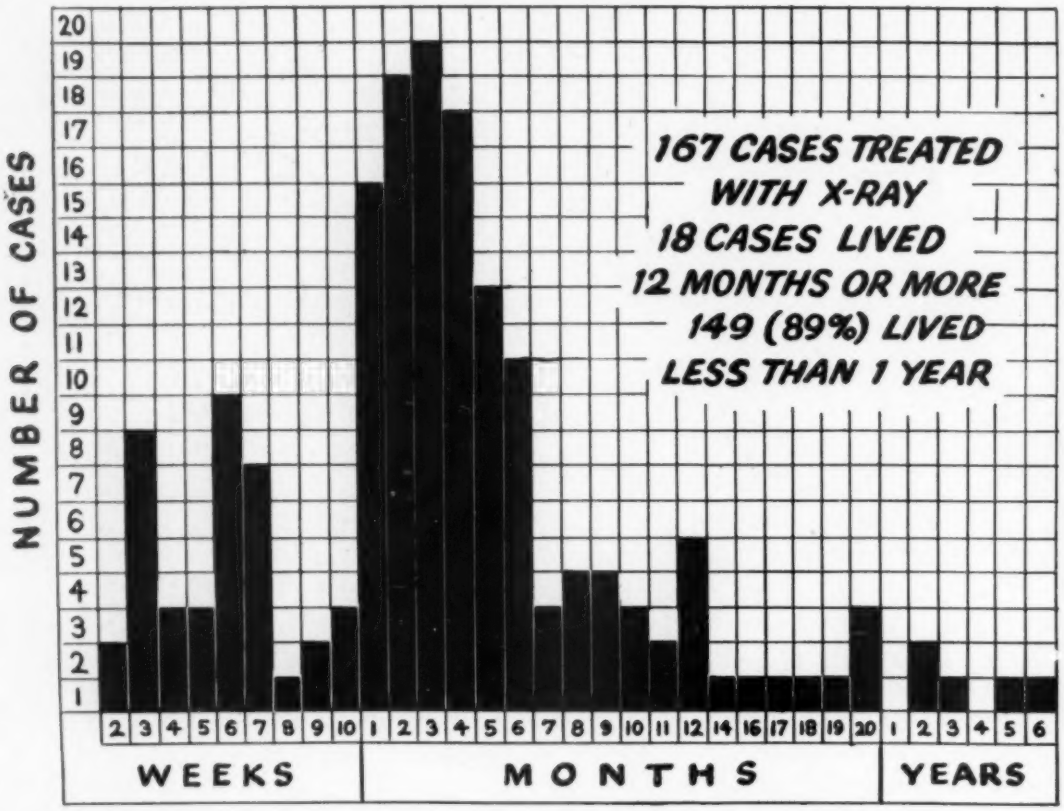


CHART III

There were 38 cases tabulated as living two to ten weeks, because they were in very poor physical condition and received less than 1,000 tissue roentgens. Of 167 cases, 149, or 89 per cent, lived less than one year; 113, or 67 per cent, lived less than six months.

All of the 5 cases living two years or more received in excess of 6,000 tissue roentgens. The patient still alive six years received 8,400 r. Many cases lived less than one year after total doses of 5,000 to 13,000 r.

There is some suggestion that cases of bronchiogenic cancer may show greater longevity cycles if greater doses of radiation could be instituted at an earlier stage of the disease, before symptoms of weakness and loss of weight develop. This would not be possible in many cases, because these were frequently the presenting symptoms when diagnostic investigations were instituted.

## DISCUSSION

The effect of irradiation in primary cancer of the lung is ultimately and almost entirely poor. The cellular character of the tumor seems to bear little relationship to the response to irradiation. Apparent resistance, regardless of the microscopic type of the disease, is very likely due to the anatomic and histopathologic structure of the bed of the disease, accentuated by frequent complications of infections.

The possibility of a malignant neoplasm existing without associated symptoms for a long period of time must be acknowledged. The progress of the disease may be insidious and hopeless stages of development found when the first symptom is manifested.

The majority of cases are advanced and inoperable when the diagnosis is established. Irradiation is the only treatment if the physical condition of the patient permits.

Evaluation of cough, dyspnea, pain, purulent and bloody expectoration, etc., for periods of one year or more are symptoms difficult to correlate with cancer. Such long durations preclude such an inference in all instances. Tuberculosis, silicosis, bronchiectasis, passive pulmonary congestion of cardiac origin, chronic nontuberculous lung infections of upper respiratory origin, and many other inflammatory conditions might explain symptoms of long duration but may likewise be sources of chronic irritation, and the actual predisposing factor in the subsequent development of a malignant neoplasm.

Any effort to evaluate the longevity cycle of a case of bronchiogenic cancer must be futile, unless the diagnosis can be established very soon after the first chest symptom.

Beneficial effects of irradiation according to the duration of life from the time of making the diagnosis offers a crude but reasonably accurate basis of formulating conclusions in a large group of cases, whose status of uncertain duration and extent of involvement possibly average some similar approximation when treatment is instituted.

It is important to consider that none of the untreated cases lived a year as compared with 18 of 169 treated cases living one to six years after instituting treatment. Furthermore, 112 untreated cases, or 94 per cent, lived less than six months, as compared with 113 treated cases, or 67 per cent, who survived less than six months. Eighty-nine per cent of 167 treated cases lived less than one year.

This evidence shows that irradiation may prolong life one to six years in approximately 10 per cent of the cases after instituting treatment.

The advantage is not spectacular when account is taken that approximately 90 per cent of irradiated cases lived less than a year as compared with 99 per cent of the untreated cases living less than nine months.

## SUMMARY

1. The prognosis was poor in this series of 286 cases of proved bronchiogenic cancer because of the advanced stage of the disease at which a correct diagnosis was made.

2. Every patient, except the few cases that may be considered as operable, should be given the benefit of every advantage which irradiation can offer and within the limits of skin and physical tolerance.

3. Since no patient who was not irradiated survived longer than a year, and since 18 patients who were irradiated lived one to six years, the value of roentgen therapy as a palliative procedure for bronchiogenic cancer seems unquestionable.

4. Irradiation may prolong life a year or more in approximately 10 per cent of cases, regardless of the microscopic cellular character of the lesion.

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## DISCUSSION

DR. U. V. PORTMANN, Cleveland, Ohio. When discussing results of roentgen therapy for bronchiogenic cancer, it is necessary to compare them with other methods of treatment and explain the reasons for successes and failures. When considering either surgical or radiological procedures for malignant tumors, we are confronted with technical and biological limitations due to growth characteristics of tumors which influence anatomical extent of involvement or accessibility.

The first technical difficulty is the diagnosis. The symptoms, physical signs, and roentgenological features of bronchiogenic cancer may simulate many diseases. The onset is insidious, and symptoms obscure; therefore, in many cases extension has taken place to the pleura or mediastinal structures, including the lymph nodes, before a diagnosis is made. Clinical and roentgenological manifestations depend upon the duration, location, extent of involvement by the neoplasm, and degree of obstruction to lung tissue. Therefore in the absence or presence of symptoms or signs that suggest bronchiogenic cancer, it should be considered when a parenchymal shadow is seen in the roentgenogram of an adult lung because a bronchiogenic tumor seldom can be visualized except by special techniques but the parenchymal shadow is made principally by reactionary or secondary pneumonitis.

Since a positive diagnosis of bronchiogenic cancer cannot be made from clinical or roentgenological characteristics, other procedures must be resorted to. No doubt bronchoscopic visualization and biopsy are most valuable and successful in about 65 per cent of cases, because these tumors originate in or extend into main bronchi and are accessible. Aspiration biopsy under fluoroscopic control is sometimes useful when tumors are inaccessible bronchoscopically. Microscopic examination of aspirated pleural fluid may be helpful if tumor cells are found, but if they are not demonstrable the method is valueless. Finally, a diagnosis may be established by thoracotomy or autopsy, the latter too frequently following immediately after the former, and neither helping much in treatment.

In discussing the results of roentgen therapy for bronchiogenic cancer, we should also consider its indications and limitations with surgical procedures.

Surgeons have said that thoracotomy is indicated (1) when a diagnosis has been established but "operability" is questionable; (2) when primary cancer is suspected, but not proved pathologically; (3) for cases with proved bronchiogenic cancer but without clinical manifestations of metastases and in spite of roentgenological evidence of possible mediastinal involvement which may be only lymph nodes enlarged by inflammation; (4) even with complete atelectasis of a lung which may be caused by edema secondary to cancer or other type of tumor such as a polyp in a bronchus. Also that pneumonectomy is indicated even if there is direct extension into the chest wall which may be excised, but this condition decreases the possibility of cure because metastasis may have occurred through intercostal lymphatics.

The contraindications to thoracotomy are said to be (1) obvious distant metastases, (2) cancer located at the carina or in the trachea, (3) presence of Horner's syndrome indicating mediastinal involvement of sympathetics.

According to these indications and contraindications most patients with bronchiogenic cancer are "operable." But results reported by courageous surgeons of very few cases surviving five years are not convincing that many are "surgically curable" or even benefited because of technical difficulties due to extent of involvement. However, many patients are treated by roentgen therapy for bronchiogenic cancer with and without positive diagnosis because of contraindications to operation.

There are biological and physical difficulties

that confront radiologists in the treatment of bronchiogenic cancer.

Biological difficulties are due to the variability of growth characteristics of these neoplasms. They originate from epithelial cells in basal layers of the bronchi or bronchioles, some from squamous cells in the mucosa, others from secretory cells in mucous glands. But no matter where they originate the degree of differentiation of parent cells determines the growth characteristics which are responsible for tumors of different histopathological types that may be predominantly squamous cell, adenocarcinoma or round, spindle or oat cell carcinoma. However, bronchiogenic cancer is not one of these histopathological types uniformly throughout but the morphology varies in many areas although one type may predominate. Likewise the degree of differentiation of the neoplastic cells also varies considerably in different tumors and in many areas of any tumor no matter what the predominant histopathological type.

These biological characteristics explain the physical difficulties of roentgen therapy.

We know that undifferentiated neoplastic cells may be radiosensitive relative to those that are highly differentiated and radioresistant and that most epithelial neoplastic cells have the latter characteristic. Also that neoplastic epithelial cells of a bronchiogenic cancer of any histopathological type vary in degrees of differentiation both qualitatively and quantitatively in many areas. Therefore some cells or parts of a neoplasm may be radiosensitive but the majority are radioresistant. We have learned that few cancers in any location are so radiosensitive that they can be destroyed by as little as 5,000 tissue roentgens and most require twice as much. But at present it is impossible to administer 10,000 tissue roentgens with impunity to areas involved by bronchiogenic cancer. Also we probably do not administer so much as calculated from dosage charts because aerated lung surrounding a tumor is not such a good scattering medium as solid materials used to measure dosage in physics laboratories. Therefore, though some neoplastic cells in bronchiogenic cancers may be destroyed by roentgen therapy with quantities that can be administered, it is biologically and physically impossible to destroy all of them.

If this be conceded, we may ask why and when treatment is indicated and what results or benefits may be expected. Unfortunately some clinicians judge benefits of therapeutic procedures principally from statistical evidences that the percentage of survivals for a specified time is higher in comparison with other methods or no treatment. But not all benefits can be calculated mathematically. Although radiologists may be unable to prove statistically that roentgen irradiation has cured patients with bronchiogenic cancer and they are reluctant even to maintain that lives have been prolonged, still there is adequate objective and subjective evidence that benefits have been derived by extension of economic usefulness and palliation.

No doubt irradiation destroys some neoplastic cells of bronchiogenic cancer and diminishes the vascularity by effects on capillaries thus reducing the mass which may relieve bronchial obstruction. But, in my opinion, the greatest benefits are derived from effects of irradiation upon lung tissues and enlarged lymph nodes not necessarily involved by cancer but affected secondarily by concomitant infection and inflammation which are responsible for atelectasis or obstructive pneumonitis. This condition in the lung will be affected by irradiation in the same way that inflammation in other tissues may be reduced in intensity and extent. When this happens the aeration of the lung will be increased by relief of bronchial obstruction manifest by alleviation of cough, dyspnea, expectoration, hemoptysis and pain, which patients appreciate.

Subjective improvement after treatment also may be demonstrable objectively in roentgenograms which often show increased aeration of the lung, diminution in the density and extent of pneumonitis and of pleural effusion. But this apparent improvement should not be misleading. It may not mean so much reduction in extent of involvement from the neoplasm as diminution of the obstruction pneumonitis.

These subjective and objective benefits suggest that roentgen therapy could be given for bronchiogenic cancer before surgical procedures are instituted to reduce inflammation and obstructive pneumonitis so that a better conception might be gained of the actual extent of involvement, the condition of the patient improved and operation facilitated.

# ROENTGEN STUDY OF LYMPHOGRANULOMA VENEREUM*

## REPORT OF TWENTY-FOUR CASES

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WITHIN the last few years lymphogranuloma venereum has received increasing medical study. The disease was fully described in 1890.[7] In 1901 the frequency of rectal involvement, as a part of the syndrome, was noted by Marion and Candy.[6] There was continuous research in the field with an important paper by Durand, Nicolas and Favre[2] appearing in 1913. The clinical aspects were well explored by 1925 when Frei[4] offered a diagnostic method of establishing the disease. There has been little work done in the roentgenological field. Rendich and Poppel[8] in 1939, and Steinert[9] in 1940 made some roentgen studies. Buckstein[1] also reported a few roentgen studies of the disease in his book which appeared in 1940.† It seems of definite value, however, to add the following cases, with a detailed study of the roentgen findings, to the literature on the subject.

Lymphogranuloma venereum appears first in males as a minute erosion or papule on the penis or prepuce; in females the infection is carried not to the inguinal glands but to the wall of the rectum causing a great infiltration of the outer wall of the part of the colon that presses upon the lumen.[5] The symptoms of the disease, tenesmus, constipation and mucous and bloody stools, are caused by rectal strictures above the anal orifice and ulcerating and granulating tissue covering the entire rectum. Roentgen studies show that in cases of lymphogranuloma venereum there is a destruction of the mucosa, rectal strictures, distention of the rectal pouch, single and multiple perirectal and perisigmoid sinus formation and fistulous tracts. (It may be noted that the formations are originally sinus but may become fistulous.)

Usually the roentgen picture of the disease is clear and of diagnostic value in identifying the conditions we have just mentioned. The cases summarized in Table 1 attest to this method of diagnosis. It can be seen that some of the cases were negative by the Frei test; others were operated on because of mistaken diagnosis but all of the cases showed marked evidence of the disease when they were examined roentgenologically.

### REPORT OF CASES

For the purpose of illustrating more fully the type of lesion seen in roentgen studies of these cases of lymphogranuloma venereum we present the following cases.

CASE XII. R. D., male, Negro, aged twenty-one, was admitted to the hospital February 24, 1938. He gave a history of tenesmus and loose stools dating back a year. The physical examination revealed palpable masses in the rectum. The proctoscopic examination showed a thickening of the rectal mucosa with ulcerations on the left lateral wall 2 in. above the sphincter. The Wassermann reaction was negative. The Frei test was positive. The biopsy showed an inflammatory process. The roentgen examination showed a uniform narrowing of the rectum (Fig. 1).

CASE XIX. L. A., female, Negro, aged twenty-eight, was admitted to the hospital November 16, 1939. She complained of hemorrhoids. This condition began in 1936 and she was operated on for it at that time. The physical examination, at the time of her admission to the hospital showed a stricture 3 in. above the external sphincter and a thickening of the rectovaginal septum. The laboratory report showed a nega-

† An excellent paper "Venereal Lymphogranulomatous Rectal Stricture" by Helper and Szilagyi appeared in this JOURNAL, August, 1942, some months after this article was written.

* From the Roentgen Departments of the New York City Hospital and the New York Cancer Institute.

tive Wassermann reaction and a positive Frei test. Roentgen findings disclosed an extensive rectal stricture with multiple sinus formations in the perianal region (Fig. 2).

Case xxiv. K. W., male, white, aged forty, was admitted to the hospital November 12, 1941. Seven years previous to his admission he had had an enlarged lymph node in the right groin which was incised. Then, he developed a diarrhea with blood and mucus. He received no satisfactory treatment until 1940 when he was given sulfanilamide and injection treatments. At the time of admission to the hospital he complained of diarrhea, painful defecation and constipation necessitating the use of enemas. The physical examination showed an inguinal scar and a rectal stricture. Laboratory examination showed a 4 plus Wassermann reaction. The Frei test was unsatisfactory. Roentgen examination revealed an extensive narrowing of the rectum with numerous sinus formations and retention in the sinuses after evacuation (Fig. 3).

Fig. 1. Case xii. Stricture of the entire rectum with tubular narrowing secondary to lymphogranuloma venereum.

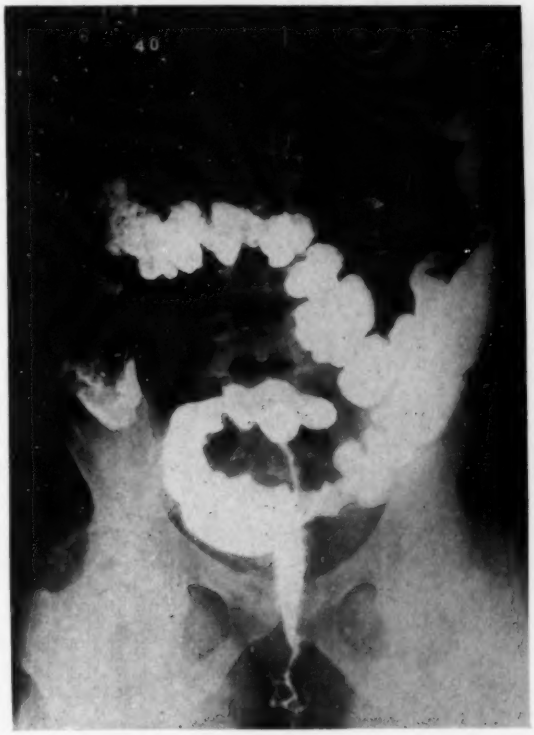

Fig. 2. Case xix. Extensive rectosigmoid narrowing with perianal sinuses.

Case xxiii. N. B., female, Negro, aged forty-three, was admitted to the hospital July 10, 1941. She gave a history of diarrhea associated with abdominal pain without blood or mucus. This condition was present for five months previous to her admission to the hospital. The physical examination was negative, except the rectal examination which showed a papillomatous nodule 1.5 in. in with associated stricture. The laboratory report stated that the Wassermann reaction was negative and the Frei test positive. Roentgen examination displayed a distention of the rectal pouch and a pronounced rectosigmoid stricture with a long irregular sinus (Fig. 4).

Case xv. V. S., female, Negro, aged forty-four, was admitted to the hospital July 30, 1937. She gave a history of having rectal bleeding and abdominal pain for the past two years. A physical examination showed no rigidity nor masses in the abdomen. The rectal examination revealed many rectal tabs above the anal orifice. Three inches above the external sphincter was an annular constriction. Proctoscopic examina-

TABLE I

| Case No. | Date | Name | Age | Sex | Race | History | Physical Examination* | Laboratory Findings | Pathological Findings | Roentgen Findings |
|---|---|---|---|---|---|---|---|---|---|---|
| I | 11-12-31 | W.H. | 48 | M | W | 1 yr. history of tenesmus, rectal bleeding and constipation; hemorrhoidectomy; later colostomy | Rectal stricture with multiple papillomatous lesions | Wass. + Frei | Biopsy—chronic inflammation | Distended rectosigmoid pouch; rectal stricture |
| II | 6-18-32 | C.V. | 28 | F | N | Painful defecation for 3 mo.; pencil stools; loss of weight | Rectal stricture | Wass. − Frei + | Biopsy—inflammatory tissue | Extensive inflammatory rectal stricture |
| III | 6-20-32 | A.H. | 34 | F | N | Fistula in ano, 1925; rectal stricture with increasing constipation, 1926; perirectal abscesses, 1929. | Rectal stricture | Wass. + Frei + | Autopsy—marked perirectal fibrosis and obstruction | Narrowing of rectosigmoid |
| IV | 2-8-34 | G.Y. | 50 | M | W | Increasing constipation, diarrhea and rectal bleeding; treated with roentgen therapy for rectal cancer without biopsy; re-admitted 2 yr. later with explosive diarrhea | Rectal stricture 3 in. above anal orifice | Wass. − Frei − | Biopsy—chronic granulomatous condition | Narrowing, irregularity and fixation of rectosigmoid |
| V | 8-9-35 | C.A. | 55 | M | N | Increasing painful defecation 5 yr. with rectal bleeding | Rectal stricture | Wass. Frei + | Biopsy—extensive inflammatory process | Sausage-shaped deformtiy of rectosigmoid |
| VI | 1-3-36 | J.D. | 64 | F | N | 20 yr. history of constipation, tenesmus and stringy stools; two operations with temporary relief | Rectal stricture above anal orifice | Wass. − Frei + | Biopsy—inflammatory productive changes | Narrowing of rectosigmoid |
| VII | 9-2-36 | H.M. | 76 | M | W | History of rectal condition since 1934 with mucoid discharge the past 3 mo. | Rectal stricture at anal orifice with adjacent area of induration | Wass. − Frei + | | Rectal narrowing |
| VIII | 6-2-37 | C.S. | 45 | F | N | Increasing constipation and diarrhea since 1915. Rectal dilatations, 1915–1921 | Rectal stricture | Wass. Frei + | | Narrowing in rectum and lower sigmoid |
| IX | 8-25-37 | F.C. | 42 | F | N | 4 yr. history of increasing constipation associated with rectal bleeding | Rectal stricture | Wass. − Frei + | | Rectosigmoid stricture |
| X | 10-26-37 | P.Z. | 35 | M | W | 25 yr. history of progressive constipation and associated diarrhea. Recent colostomy | Rectal stricture | Wass. + Frei + | | Narrowing in rectum to rectosigmoid |
| XI | 1-15-38 | P.J. | 27 | F | N | Rectal pain and discharge since June, 1937; radium treatment, relief for 1 mo., followed by colostomy | Rectal ulceration, necrosis of buttock, coccyx to vulva | Wass. − Frei + | Autopsy—chronic productive inflammation in perirectal tissue | Narrowing deformity of entire rectosigmoid |
| XII | 2-24-38 | R.D. | 21 | M | N | 1 yr. history of tenesmus with loose stools | Palpable masses | Wass. − Frei + | Biopsy—inflammatory process | Uniform narrowing of rectum |
| XIII | 4-12-38 | B.G. | 34 | M | W | 2 yr. history of rectal pain; operation; 1 yr. of later developed inguinal masses, swelling of scrotum, rectal discharge | Rectal stricture 2 in. above anal orifice | Wass. + Frei + | | Dilatation of rectosigmoid pouch and rectal stricture |
| XIV | 5-2-38 | P.K. | 59 | M | W | 1 yr. history of abdominal pain and progressive constipation; colostomy performed | Rectal stricture 1 in. above anal orifice | Wass. − Frei + | Biopsy—inflammatory tissue | Irregularity and narrowing of rectum |
| XV | 7-19-38 | V.S. | 44 | F | N | 2 yr. history of rectal bleeding associated with abdominal pain | Annular constriction | Wass. − Frei − | Biopsy—chronic granulation tissue | Marked narrowing of rectum, sigmoid and distal descendens. Small sinuses |
| XVI | 1-6-39 | B.A. | 39 | F | N | Constipation 3 yr. associated with difficulty in defecation | Rectal stricture; vaginal fistulae | Wass. − Frei | Biopsy—chronic granulation tissue | Rectal stenosis |
| XVII | 7-22-39 | B.R. | 42 | F | N | 15 yr. history of recurrent perineal abscesses, rectal stricture and rectovaginal fistula. Two opertions 9 and 5 yr. previously, temporary relief; June, 1939 cecostomy for cancer of rectum | Rectal stricture | Wass. − Frei + | Biopsy—chronic granulation tissue | Smooth narrowing of rectosigmoid suggesting inflammatory stricture; nonmalignant |
| XVIII | 9-4-39 | P.C. | 39 | F | N | Gradual abdominal distention associated with pain in lower abdomen | Rectal stricture 2 in. above anal margin | Wass. − Frei + | | Tubular narrowing of rectum to 5 cm. beyond rectosigmoid junction |
| XIX | 11-10-39 | L.A. | 28 | F | N | Hemorrhoids since 1936. | Rectal stricture; thickening of rectovaginal septum | Wass. − Frei + | | Extensive rectal stricture with perianal sinuses |
| XX | 1-14-41 | D.T. | 18 | F | N | 2 mo. history of rectal bleeding, diarrhea and painful defecation | Rectal stricture | Wass. − Frei + | | Narrowing of rectum and sigmoid |
| XXI | 1-22-41 | B.P. | 29 | F | N | Increasing rectal pain and difficulty in defecation | Rectal stricture | Wass. + Frei | Biopsy—chronic granulation tissue | Irregularity of anal canal with smooth stricture of distal two-thirds of rectum |
| XXII | 6-7-41 | R.R. | 39 | M | N | Increasing constipation with associated abdominal cramps | Rectal stricture | Wass. Frei + | Biopsy—unsatisfactory | Concentric narrowing of rectum |
| XXIII | 7-10-41 | N.B. | 43 | F | N | 5 mo. history of diarrhea associated with abdominal pain | Rectal stricture; papillomatous nodules | Wass. − Frei + | | Rectosigmoid stricture; large sinus tract |
| XXIV | 11-12-41 | K.W. | 40 | M | W | 7 yr. history of constipation, diarrhea, bloody stools with mucus necessitating frequent enemas | Rectal stricture | Wass. + Frei | | Rectal narrowing with numerous retention sinuses |

* All males had inguinal scars or palpable glands.

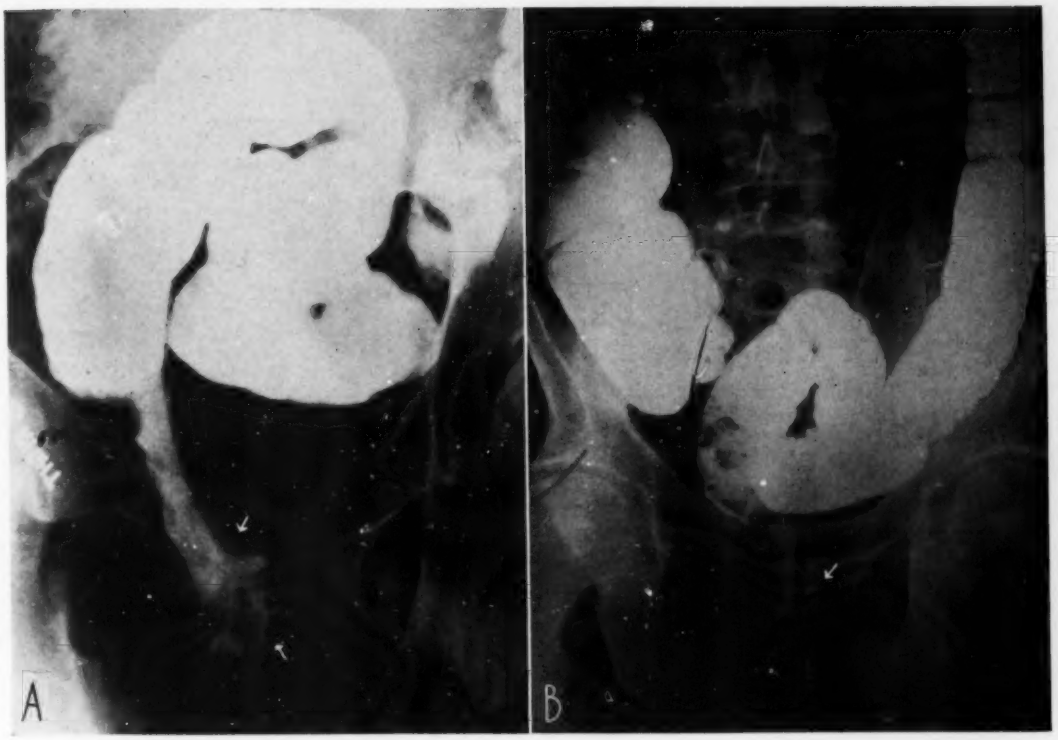


FIG. 3. Case XXIV. *A*, anorectal stricture with tubular narrowing and multiple retention sinuses in the perianal and perirectal tissues. *B*, after evacuation showing the retention in the colon proximally, also perianal and perirectal sinuses.

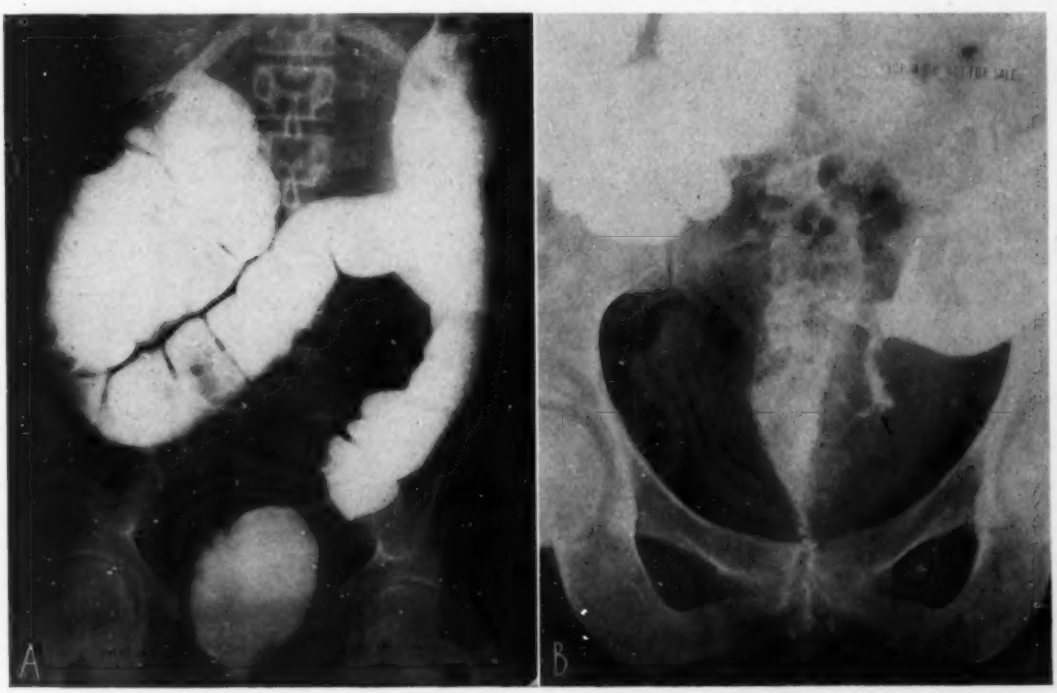


FIG. 4. Case XXIII. *A*, annular stricture of the rectosigmoid secondary to lymphogranuloma venereum simulating cancer. *B*, after evacuation; note the large sinus tract. This tract is very unusual with cancer.

tion showed a marked narrowing of the anal canal extending for 10 cm. On examination it proved to be a benign stricture. The laboratory report stated that the Wassermann and Frei tests were negative. A biopsy showed chronic granulation tissue. Roentgen examination showed a marked tubular narrowing of the rectum and sigmoid and distal descendens with an absence of normal markings. There were fine sinuses extending laterally[1] (Fig. 5).

A study of these cases indicates the various forms that lymphogranuloma venereum of the colon assumes and which can be noted in roentgen studies. However, it is important from the diagnostic angle to point out that these cases of lymphogranuloma venereum have occasionally been mistaken for cancer. Evidently, the duration of the disease is the first differentiation. Cases of lymphogranuloma venereum usually run a chronic course of years, even twenty or more. The history of cases of cancer is generally two or three years. About 75 per cent of cases of rectal cancer have the lesion on the anterior wall.[3] In lymphogranuloma venereum, although the lesions may be localized, more often they circle the wall. Lesions of lymphogranuloma venereum begin in the anal region while cancer tends to develop in the rectum. The cases shown in Figures 6, 7 and 8 illustrate these points of differentiation.

In addition to the difference in the duration and the sites of these two diseases, cancer may be identified since its lesions may cause circumscribed elevations of the mucosa with abrupt terminations and these lesions are associated with ulcerations. Cancer, on roentgen examination, shows an irregular shadow protruding into the lumen. Lymphogranuloma venereum shows, by the same method, more often a regular shadow. The exception is stenosing scirrhous carcinoma which tends to infiltrate and circle the wall and shows a

FIG. 5. Case XV. Extensive tubular narrowing involving the rectum, sigmoid and part of the descendens with occasional fine sinuses.

FIG. 6. Malignant stricture of rectal ampulla. Lymphogranuloma can be excluded since the rectum below the stricture, down to the anus, has normal mucosal folds.

Fig. 7. Cancer of the lower rectum simulating lymphogranuloma venereum as a result of its location. Note the absence of tubular narrowing and fungating luminal deformity.

Fig. 8. Cancer of the proximal rectum with annular narrowing. Broadening mucosal pattern distally fading into a normal mucosal fold at the anorectal junction.

smooth shadow on roentgen examination. Ruptured multiple diverticula associated with cancer is the other exception in considering the differential diagnosis.

SUMMARY

Lymphogranuloma venereum of the colon, as studied in 24 cases, tends to develop certain characteristics which can be shown definitely by roentgen examination. These characteristics are destruction of the mucosa, rectal stricture, distention of the rectal pouch, single and multiple perirectal and perisigmoid sinus formation and fistulous tracts. The condition is sometimes mistakenly diagnosed without a roentgen examination. It therefore seems advantageous to use the roentgen ray as an aid in establishing the diagnosis and extent of this disease.

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# DATA ON THE ATTENUATION OF NARROW AND BROAD BEAMS OF 1,000 KILOVOLT (PEAK) ROENTGEN RAYS BY LEAD, CONCRETE AND WATER*

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THE protection of operating personnel from supervoltage radiation requires the construction of relatively costly and inconveniently bulky barrier walls. For radiations corresponding to 600 kilovolts, constant potential, and below, the amount of lead or other material required is relatively small. It can be satisfactorily added to the walls of an existing structure, and applied according to authoritative recommendations now in existence.[1,7] But for radiations corresponding to voltages in the neighborhood of 1,000 kv. (peak) and above, the great weight and thickness of the necessary walls introduce serious architectural problems. Special walls are required, and often special buildings; and the space occupied by the walls often equals the useful treatment room space.

In the supervoltage region, therefore, it becomes most profitable to choose with care the most suitable barrier materials and to calculate precisely the necessary and sufficient thickness. Unfortunately much less experimental data have been available for this purpose than in the case of softer radiations. Theoretical treatment must take into account radiation that is scattered by walls which are struck by rather wide roentgen-ray beams. In the region of 1,000 kv. (peak) the problem is complicated by the great thickness of the walls required and by the fact that the mechanism of absorption is still dependent, to some extent, upon the nature of the absorbing material used.[2]

Although a number of other special materials have been proposed, protective barriers are generally constructed of lead or concrete, or the two combined. The attenuation due to distance is called upon whenever possible in order to reduce the amount of lead or concrete required. In general, in supervoltage therapy, the use of lead is restricted to regions close to the tube anode, and concrete to walls and floors distant from it.

Concrete barriers are usually subjected to broad beams of radiation. They must reduce the intensity of these broad beams to below the tolerance level. Concrete is a relatively light material, composed of elements of low atomic weight, and consequently can be expected to scatter very high voltage radiations somewhat as water does.[2] The thickness of concrete required must at present be calculated from absorption data, with allowances being made for the scattering of radiation out of the broad beams penetrating the concrete. The importance of this scattering factor is demonstrated by the experiment described at the end of this paper.

With the aid of the supervoltage therapy equipment at Memorial Hospital, it was possible to measure the attenuation of narrow beams of 1,000 kv. (peak) roentgen rays in very thick blocks of lead, concrete, and water. It was found possible to study one special case of the general problem of the penetration of broad beams through concrete.

## EQUIPMENT

The roentgen-ray equipment used[3] consisted of a cascade type tube housed in a pressure tank together with its transformer. A 180 cycle, alternating potential, with peaks of 1,000 kv. could be applied to the tube. Unfortunately, this potential could

* Presented at the Twenty-fifth Annual Meeting, American Radium Society, New York, N. Y., June 10–11, 1940.

not be measured during the experiment but depended upon the calibration at the factory. It was, however, readily reproducible and could be monitored by the "charging current" drawn by the transformer. The tube current at full voltage was maintained at 3 milliamperes.

The anode of this tube is shielded by a housing of lead, steel, and mercury, so designed that a beam of radiation may be directed at any angle between vertically downward and the horizontal.[4] For the following experiments only the downward direction was used, the radiation being in the same direction as that of the cathode rays. The radiation passed through the tungsten target, the water jacket, and then through about 2 mm. of mercury. The approximate inherent tube filter is stated in Figure 2.

The focal spot was measured by means of pin hole photographs and was about 2 cm. in diameter.

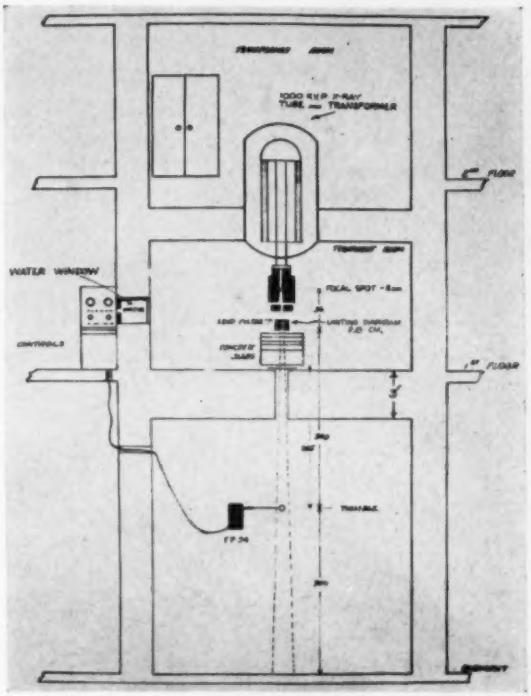


Fig. 1. Technique of determining the absorption of narrow beams by concrete, water, and lead. A cross section of the transformer and tube is shown, as well as the positions of filters and measuring instruments. Distances in centimeters.

## NARROW BEAM ABSORPTION MEASUREMENTS

In the first instance, and following the procedure generally used at lower voltages,[1] the true absorptions of lead, concrete, and water were determined by using a narrow beam of radiation. In this manner the behavior of concrete as an absorber could be compared with that of a lighter material (water) as well as that of a heavier material (lead).

Figure 1 shows the experimental setup in cross section. A hole in the floor of the treatment room, directly below the target, permitted a narrow collimated beam to be projected into the well shielded room below. The floor of the treatment room is made of concrete and is 3 feet thick. Very little leakage through this floor was detected.

The intensity of radiation was measured by thick walled thimble chambers connected to an electrometer tube network and current compensator. The ionization chamber could be placed at a great distance from the filter, as shown in Figure 1.

The limiting diaphragm, 10 cm. thick, shown in Figure 1, permitted a beam to pass through the hole in the floor without grazing the latter. When lead fore-filters were used they were placed just above the limiting diaphragm. The heavy concrete slabs, as well as the tank of water, were placed on the floor of the treatment room over the hole.

## CONCRETE AND WATER ABSORBERS

The concrete blocks were made of Portland cement, sand and small gravel (up to about 8 mm. in diameter), in the ratio of about 1:2:2. It was wet-cast into wooden frames, 2 feet square and with various thicknesses. A slight tamping, corresponding to conventional builder's practice, was given the wet material and it was then set aside to dry indoors for several months. The blocks were then weighed and measured. The specific gravity of the seasoned blocks averaged 2.2 and varied among the samples from 2.13 to 2.23.

Two blocks were made of 2 inch thickness, and one each of 4, 6 and 10 inch thickness. In this way the same nominal absorber thickness could be obtained from several combinations of the blocks. The transmissions through all possible combinations of the blocks, as well as through different regions of individual blocks and combinations, were determined and practically no inhomogeneity was discovered. The density of the concrete was satisfactorily uniform.

The water absorber consisted of a tank having a paraffined paper bottom. It was placed over the hole in the treatment room floor. It could be filled to a depth of about 60 cm. and the attenuation due to any chosen thickness of water determined.

### ABSORPTION CURVES

Figure 2 shows the absorption of the narrow beam in lead and concrete as determined with the technique described above, the initial filtration being that inherent in the tube head. (See value in Figure 2.)

Figure 3 compares the attenuations of the narrow beam by water, concrete and lead, with several lead thicknesses used as fore-filters. The concrete and water curves are almost straight lines on the semilog plot, within the experimental error. It is evident that concrete, like water, adds very little to the hardness of the transmitted beam, whereas lead continues to absorb 1,000 kv. (peak) radiation selectively even after as much as 40 mm. of lead are penetrated.

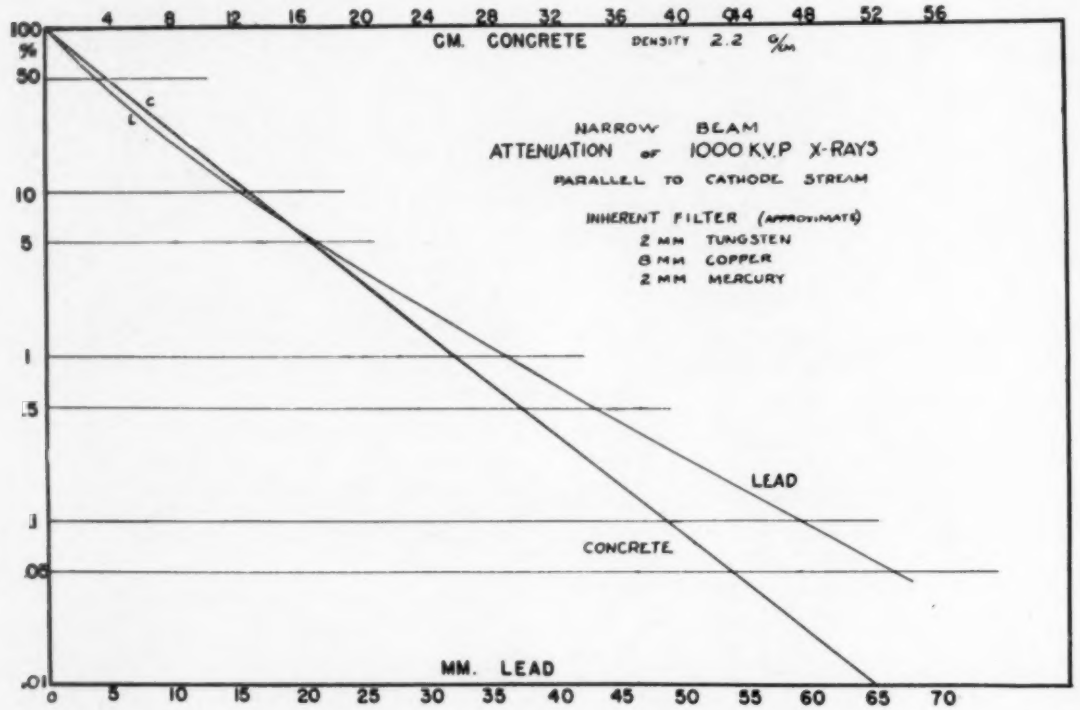


FIG. 2. Attenuation of narrow beams by lead and by concrete determined by technique shown in Figure 1.

If desired, the "lead equivalent" of any thickness of concrete up to 50 cm. can be obtained from Figure 2. The "lead equivalent" is defined as[1] the thickness of lead which will have the same true absorption for the given roentgen-ray beam as the protective material in question. A comparison of the "lead equivalents" for 1,000 kv. (peak) radiation and those for radium and lower voltage roentgen rays are given in Figure 4.

The mass and electronic absorption co-

efficients in lead, concrete and water from the data of Figures 2 and 3 are given in Table 1. The electronic scattering coefficients are calculated on the assumption that the effective atomic weight of concrete is not far from that of silica. The accuracy implied by the data in Table 1 is, of course, presumptuous, considering the assumptions made, but three significant figures are shown to illustrate the trend in the coefficients as the beam of radiation is progressively hardened by the addition of lead fore-filters. It is evident that 1,000 kv. (peak) radiation is absorbed in concrete in the same manner as it is absorbed in water, namely through the Compton process.

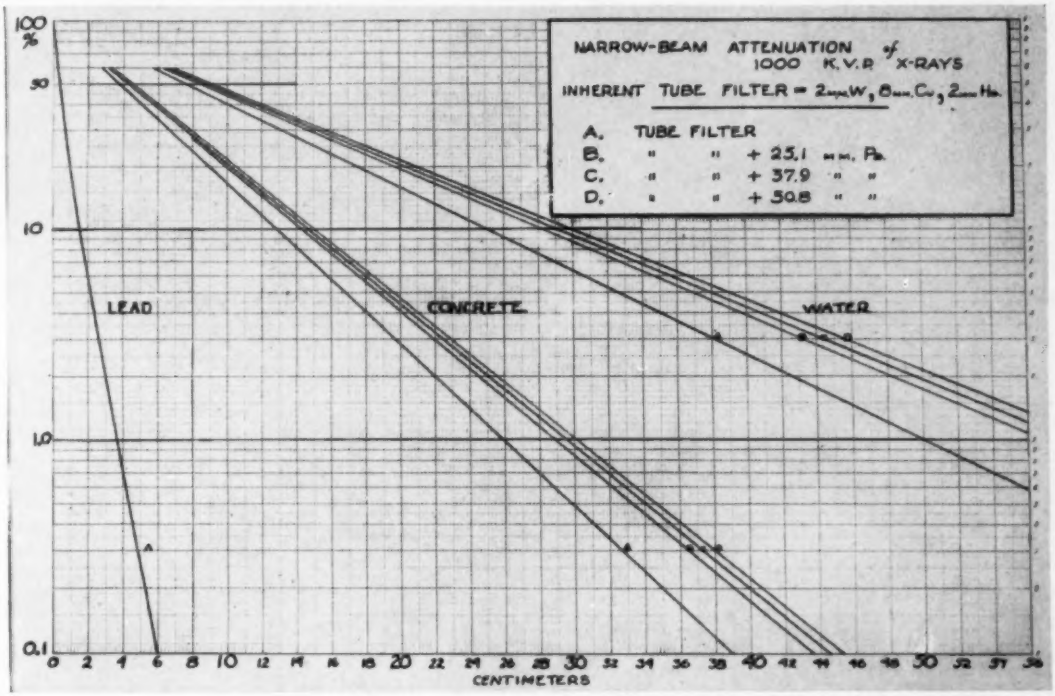
NARROW-BEAM ATTENUATION of 1000 K.V.P. X-RAYS
INHERENT TUBE FILTER = 2 mm. W, 8 mm. Cu, 2 mm. Hg
A. TUBE FILTER
B. " " + 25.1 mm. Pb.
C. " " + 37.9 " "
D. " " + 50.8 " "
LEAD
CONCRETE
WATER
100 %
50
10
1.0
0.1
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56
CENTIMETERS

Fig. 3. Absorption of the narrow beam (shown in Fig. 1) by lead, concrete, and water, showing the effect of addition of extra lead fore-filters.

### PENETRATION OF BROAD BEAMS

The experimental work of Kaye, Bell and Binks[5] illustrates very clearly the magnitude of the scattered component of a broad beam of gamma rays penetrating a protective barrier. They compared the penetration of a brick wall by gamma rays of narrow and very broad beams. From their work it can be concluded that, if the thickness of a brick wall were to be determined from the narrow beam attenuation coefficients corresponding to gamma radiation, at least two and one-half additional half-value layers of brick would be required to make the wall a safe barricade. This amounts to thickening the wall about 40 per cent. The hardness of radiation used by the above authors was equivalent to about 1,500 kv. monochromatic.

It was thought worth while to determine experimentally the order of magnitude of the effect of broadening a beam of 1,000 kv. (peak) radiation penetrating a thick block of concrete. Unfortunately a full sized wall could not be set up at this laboratory and so only the special case of a moderately broad beam, of a size often found in therapy, with the ionization chamber close to the scatterer could be tested.

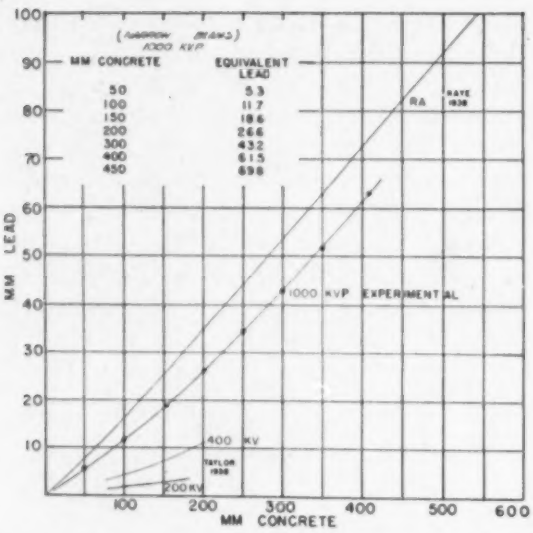


FIG. 4. Equivalence of lead and concrete as absorbers of narrow beams of 1,000 kv. (peak) roentgen rays, as well as values for radium given by Kaye[6] and for lower voltage roentgen rays given by Taylor.[7]

Figure 5 shows the experimental setup. A concrete block was chosen of such a thickness (14 inches) and placed at such a distance from the target that approximately the accepted tolerance dose was transmitted. The concrete block was suspended in mid-air by means of a cradle held by chain tackle. The intensity of radiation at 50 cm. from the target was 100 r per minute, our usual therapy intensity. The filter was that inherent in the tube.

The thimble chamber, having about 4 mm. wall thickness, was placed at a chosen distance (marked $x$ in Figure 5) from the lower face of the concrete block. The concrete was first exposed to a beam 30 cm. in diameter and the transmitted intensity determined. Then, without varying any other condition, the beam diameter was reduced to 10 cm. by inserting a constricting diaphragm at $B$, see Figure 5. This procedure was repeated for several values of $x$.

For each value of $x$ the ratio of intensity transmitted by the wide beam over that transmitted by the narrower one was determined and these are given in Table II.

Since some radiation necessarily struck the floor below the suspended blocks and was partly scattered back, this error had to be accounted for. This was done by displacing the thimble chamber horizontally so that it was out of the direct beam, and at the same time shielding the thimble with a block of lead from that radiation scattered from the suspended concrete, but not from that coming from the floor and lower walls. This procedure yielded only a first order correction, but the results showed that this correction factor was fortunately small. The ratios corrected in this manner are shown in the third column of Table II.

Even the 10 cm. diameter beam cannot be considered truly narrow in this instance, especially when the value of $x$ was small. Some scattered radiation would reach the chamber when it was close to the concrete.

TABLE I

ATTENUATION OF NARROW BEAMS OF 1,000 KV. (PEAK) ROENTGEN RAYS

Absorption Coefficients from Slopes of Experimental Curves in Figure 3

| Fore-filter | Concrete | | | Water | | | Lead | | |
|---|---|---|---|---|---|---|---|---|---|
| Lead mm. | $\mu$ cm.$^{-1}$ | $\mu/\rho$ | $e^{\sigma}$ | $\mu$ cm.$^{-1}$ | $\mu/\rho$ | $e^{\sigma}$ | $\mu$ cm.$^{-1}$ | $\mu/\rho$ | $e^{\sigma}$ |
| Tube | 0.177 | 0.0805 | $2.71\times10^{-25}$ | 0.0920 | 0.0920 | $2.73\times10^{-25}$ | 1.88 | 0.166 | $6.91\times10^{-25}$ |
| +25.1 | 0.158 | 0.0718 | 2.41 | 0.0808 | 0.0808 | 2.40 | 1.11 | 0.098 | 4.06 |
| +37.9 | 0.155 | 0.0705 | 2.37 | 0.0789 | 0.0789 | 2.34 | 1.01 | 0.089 | 3.72 |
| +50.8 | 0.152 | 0.0691 | 2.33 | 0.0772 | 0.0772 | 2.29 | 1.00 | 0.088 | 3.68 |

$\mu$ = absorption coefficient per centimeter.
$\mu/\rho$ = mass absorption coefficient.
$e^{\sigma}$ = electronic absorption coefficient.

Its magnitude could be determined by using the data of the experiment shown in Figure 1 where the concrete absorber was at a great distance from the thimble chamber. The ratio of measured intensity due to the wide beam over the intensity calculated from the narrow beam attenuation curves was determined. These values are shown in Table III.

## CONCLUSIONS

The data in Table III indicate the order of magnitude of the error which might arise when one calculates the thickness of a concrete barrier wall by using nothing more than the ordinary narrow beam attenuation coefficients pertaining to concrete and to this potential. At least two additional half-value layers of concrete would be needed to compensate for scattering. This means that an additional thickness of 8 cm. of concrete must be added to the value calculated on narrow beam data.

The results of the experiment described above and illustrated in Figure 4 answer, of course, only part of the question involved in the whole protection problem. In most instances the scattered radiation which must be excluded from personnel covers a large area of the barrier wall and scattering from very wide angles must be considered. A complete experimental study of this nature requires the construction of full scale walls, and walls placed at several distances from the source of radiation. This, unfortunately, could not be carried out.

It is well to point out that the recent development of compact roentgen-ray machines operating at 1,000 kv., and over, in the investigation of metal welds and castings will eventually be utilized in roentgen therapy installations. In such cases the

Table II

| Distance $x$ of the thimble from the concrete block in centimeters | Ratio of intensity due to 30 cm. beam over that due to 10 cm. beam | |
|---|---|---|
| | Measured | Corrected for floor scattering |
| 6.5 | 2.5 | 2.4 |
| 17.5 | 2.3 | 2.1 |
| 35.0 | 1.8 | 1.6 |
| 122.0 | 1.4 | 1.4 |

Table III

| Distance $x$ of the thimble from the concrete block in centimeters | Ratio of the corrected intensity due to the 30 cm. beam over the intensity calculated from narrow beam attenuation curves |
|---|---|
| 6.5 | 3.3 |
| 17.5 | 2.4 |
| 35.0 | 1.6 |
| 122.0 | 1.4 |

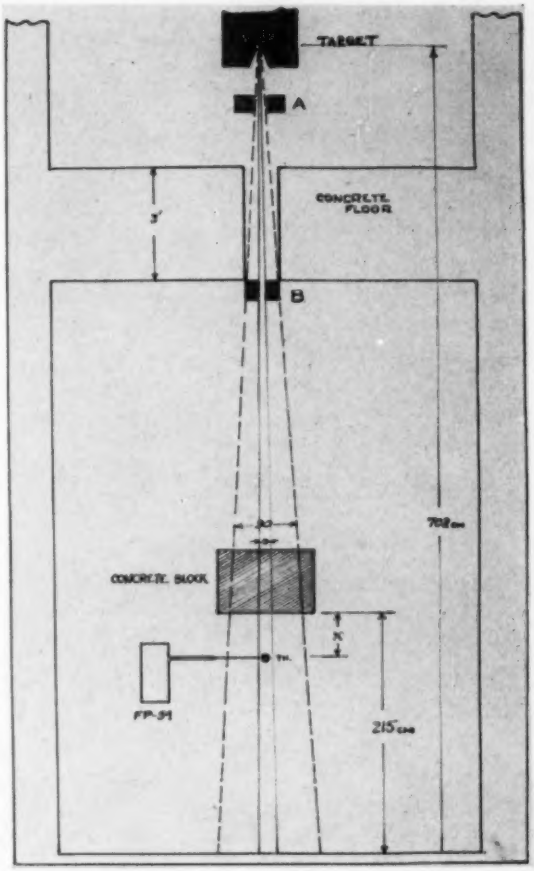


Fig. 5. Method of studying the effect of the width of a beam on the penetration of a thick concrete block.

useful roentgen-ray beam may be pointed in almost any direction and consequently adequate protection of the operating personnel will require the construction of walls, floors, and ceiling of sufficient thickness. It remains to be seen whether it will be economically feasible to construct concrete walls of somewhat smaller thicknesses covered with lead sheeting. The latter, from a physical standpoint, might prove to be a more efficient absorber of the radiation scattered by the main concrete wall.

SUMMARY

The absorption of narrow beams of 1,000 kilovolt (peak) roentgen rays by thick layers of lead, concrete, and water has been experimentally determined. A simple experiment is described which illustrates the effect of scattering of a broad beam as it penetrates thick barriers of concrete, such as are commonly used to protect personnel.

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# THREE AND ONE-HALF YEARS' EXPERIENCE WITH THE 1,000 KILOVOLT ROENTGEN THERAPY UNIT AT MEMORIAL HOSPITAL*

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FROM August 1, 1939, to February 1, 1943, 375 patients with cancer were treated by the 1,000,000 volt machine at Memorial Hospital. A study was made of the records of only those patients, 315 in number, who had finished their treatments by November 15, 1942.

Although it is too early to draw any conclusions as to the survival rate of patients treated by the 1,000,000 volt machine, nevertheless the analysis of these records revealed certain advantages and disadvantages of this unit as compared with the 200,000 volt machine.

This paper, therefore, is an account of what happened to 315 patients with cancer who were treated by a 1,000,000 volt machine, and is an expression of opinion as to the value of this higher unit in roentgen therapy.

The machine in use at Memorial Hospital consists of a low frequency resonance transformer in which is placed a coaxially mounted multi-section roentgen tube. Both the transformer and the roentgen tube are contained in a grounded steel tank. Freon 12 gas is used for insulation. The roentgen rays are generated from a target mounted in the end of an extension chamber projecting out from the bottom of the grounded tank.

The unit is simple, compact, and free from exposed high voltage. A considerable degree of flexibility has been gained through a device† which permits an adjustment of the radiation beam on a vertical plane at any angle from vertical to horizontal.[1] This flexibility is accomplished, in part, by surrounding the roentgen-ray source with an 11.2 cm. layer of mercury in a suitable steel tank in which a hollow truncated steel cone is so placed as to provide a "window" in the mercury through which the roentgen-ray beam may pass at the desired angle.

Thus the great objection which many have had to the supervoltage unit, its inflexibility, has been largely overcome, for at Memorial Hospital the machine can be adjusted to the patient, not the patient to the machine.

The importance of this careful positioning of the roentgen-ray beam with respect to the lesion to be treated cannot be overestimated. This is especially true when small beams are used, as they are in the higher voltage unit, because of the relatively larger gain in depth dose.

The chosen position of patient and roentgen-ray beam should be maintained throughout the treatments. The added flexibility of angulations of the beam enables the radiologist to make the desired setup with the patient in a comfortable position, thus lessening the possibility of the patient changing his position during the course of the treatment.

To make doubly sure that the beam is at all times properly directed, the patient is under constant observation by the technician through a window, which, while providing a full view of the treatment room, at the same time affords the technician complete protection from roentgen rays. This window‡ consists of a glass "aquar-

† Designed by Dr. G. Failla.

‡ Designed by Dr. G. Failla.

* Read in part at the Forty-second Annual Meeting, American Roentgen Ray Society, Cincinnati, Ohio, Sept. 23–26, 1941.

TABLE I

CLASSIFICATION OF PATIENTS WITH CANCER

| | Total number of cases | Suitable | Unsuitable |
|---|---|---|---|
| Lung | 93 | 59 | 34 |
| Esophagus | 62 | 39 | 23 |
| Stomach | 29 | 9 | 20 |
| Bladder | 25 | 13 | 12 |
| Prostate | 17 | 7 | 10 |
| Rectum | 17 | 14 | 3 |
| Cervix and vagina | 17 | 6 | 11 |
| Ovary | 13 | 5 | 8 |
| Bone | 9 | 8 | 1 |
| Miscellaneous* | 33 | 10 | 23 |
| Total | 315 | 170 | 145 |

* The miscellaneous group includes patients with retroperitoneal sarcoma, Hodgkin's disease, lymphosarcoma, and those with cancer of the pancreas, uterus, gallbladder, tonsil, kidney and parotid gland.

ium," filled with water, which fits closely in an opening in the concrete wall of the treatment room.

Still another device has been provided to insure accuracy of dosage. It consists of an integrating and recording dosimeter.* It provides a graphic record of each treatment. The ionization chamber of this instrument is only 0.63 cm. in diameter and 1.5 cm. in length. Because it is so small it records the dose delivered to the skin, including back scatter. The chamber is connected to the measuring device by means of two flexible cables about 0.5 cm. in diameter and 15 feet in length. It is readily attached to the patient at the center of the field to be irradiated. If the patient were to move during the treatment, the chamber would be displaced with respect to the roentgen-ray beam, and if the movement were considerable, it would show on the graphic record.

By these several devices, the flexibility of the machine and the accuracy of the beam are made possible.

At the Memorial Hospital the following factors are used with the 1,000,000 volt machine: a tube current of 3 ma.; a filter consisting of 2 mm. tungsten, 2 mm. mercury, 8 mm. copper, and several millimeters of water. These form a half-layer value of 3.8 mm. of lead. The target skin distance is 70 cm. The intensity of the vertical beam is 50 r per minute.

* Designed by Dr. G. Failla and the Leeds and Northrup Company.

No selection of patients was made for treatment by the 1,000,000 volt machine. The majority, however, were in the advanced stages of the disease, since those patients who have failed to improve under other treatments are often the first to be subjected to new methods of treatment.

Of these 315 patients, 145 were unsuitable for use as a means of judging the value of the treatment. They were either too sick to finish even the original outlined course of treatments, or had proved liver or peritoneal metastases, or on first examination revealed widespread metastases to bones or lymph nodes. The remaining 170 patients, many with inoperable or recurrent cancer, were classified as suitable.

The data here presented, however, include all patients, suitable and unsuitable.

In Table I, the 315 patients are classified according to the form of the disease.

Ninety-nine of the 315 patients had received previous treatment, either surgical or radiation.

In only 32 patients of the 315 was there no microscopic proof of disease. Of these 32 patients, 10 had recurrent disease which had been proved formerly by biopsy; and 4 had gross evidence of inoperable cancer, revealed by exploratory operation. No biopsy was taken of these 4, however, as it was considered unnecessary to do so. In only 18 of the entire series of 315 patients, therefore, was the disease histologically unproved.

The treatments were given in daily fractional doses of 250 to 400 r, measured in air. As a rule the patients tolerated them better than similar patients under the 200,000 volt machine. Roentgen sickness was less; it was not even a problem. With a few exceptions the skin reaction from a total dose ranging from 2,100 to 5,000 r per portal was not severe.

The actual tumor dose in roentgens was calculated by the usual method. The depth dose data were taken from measurements made by Quimby and Focht[6] on the machine used in these treatments.

An analysis of the groups presented in Table I follows.

The largest groups were made up of those treated for cancer of the lung and of the esophagus. In fact, during this three and one-half year period all patients, with few exceptions, who were admitted to the hospital with one or the other of these diseases were treated by the 1 million volt unit.

### CANCER OF THE LUNG

Of the 93 patients treated for cancer of the lung, 21 are alive, 68 are dead, and 4 have been lost track of. The survival rate is shown in Table II.

The cases of lung cancer were usually treated through two circular fields, one anterior and one posterior. The size of the fields varied with the size of the tumor. At times a lateral field was added. The daily dose ranged from 250 to 400 r and the total dose for each field from 4,000 to 5,200 r.

The following case report shows the favorable result from the use of the 1 million volt unit in treatment of cancer of the lung.

Case 1. *Diagnosis:* Superior sulcus bronchogenic carcinoma with rib destruction.

*Histopathological Diagnosis:* Bronchogenic cancer.

*Treatment:* The patient was treated through an anterior and a posterior field each receiving 300 r to one field daily with a total dose of 4,500 r to each circular field 11.5 cm. in diameter The tumor dose was 4,500 r (Fig. 1).

*Subsequent Course:* The condition of the patient is excellent. The roentgenograms of the chest, fifteen months after finishing the treatment, show complete regression of the tumor (Fig. 2, *A* and *B*).

### CANCER OF THE ESOPHAGUS

Of the 62 patients treated for cancer of the esophagus, 11 are alive, 47 are dead, and 4 have been lost track of.

The survival rate is shown in Table III.

The esophageal cancers were treated through four fields, two anterior and two posterior. The size of the field was usually 14 by 7 cm. The patient received from 300 to 400 r to each field daily, with an average total dose ranging from 3,600 to 4,200 r for each field.

The following case illustrates the favorable result of this treatment.

Table II

CANCER OF THE LUNG

| Alive: 21 | | | | |
|---|---|---|---|---|
| More than 2 yr. | Two yr. | More than 1 yr. | Between 6 and 12 mo. | Between 3 and 6 mo. |
| 4 (2 N.E.D.*) (2 with disease) | 1 (with disease) | 6 (5 N.E.D.) (1 with brain metastases) but primary controlled | 6 (3 N.E.D.) (2 with disease) (1)? | 4 (1 N.E.D.) (3 too soon after finishing treatment to be proved) |
| **Dead: 68** | | | | |
| After a period of more than 2 yr. | After a period of 2 yr. | After a period of more than 1 yr. | After a period between 3 and 12 mo. | After a period between 3 days and 3 mo. |
| 0 | 0 | 9 | 32 | 27 |

* N.E.D. = No evidence of disease.

CASE II. *Diagnosis:* Cancer of esophagus.

*Histopathological Diagnosis:* Epidermoid carcinoma, Grade 3.

*Treatment:* The patient was treated through four fields, two anterior and two posterior. The size of the field was 14 by 7 cm. He received a total dose of 4,200 r to each field with a tumor dose of 8,000 r (Fig. 3).

*Subsequent Course:* The patient who had been able to swallow only liquids is now able to eat everything without difficulty. He is in excellent general condition. The roentgenograms, nine months after treatment, show a normal esophagus (Fig. 4, *A*, *B*, *C*, *D*).

The result of the esophagoscopic examinations before and after treatment is as follows:

May, 1942, before treatment. The esophagoscope was passed with difficulty and at a distance of 18 cm. from the incisor teeth there was a fungating ulcerated lesion which was most prominent on the posterior lateral walls. It seemed to obstruct the esophagus almost completely.

September, 1942, after treatment. The esophagoscope was passed without difficulty and at a distance of 18 cm. from the incisor teeth a stricture was noted. There was no bulging within the lumen. Although the mucosa

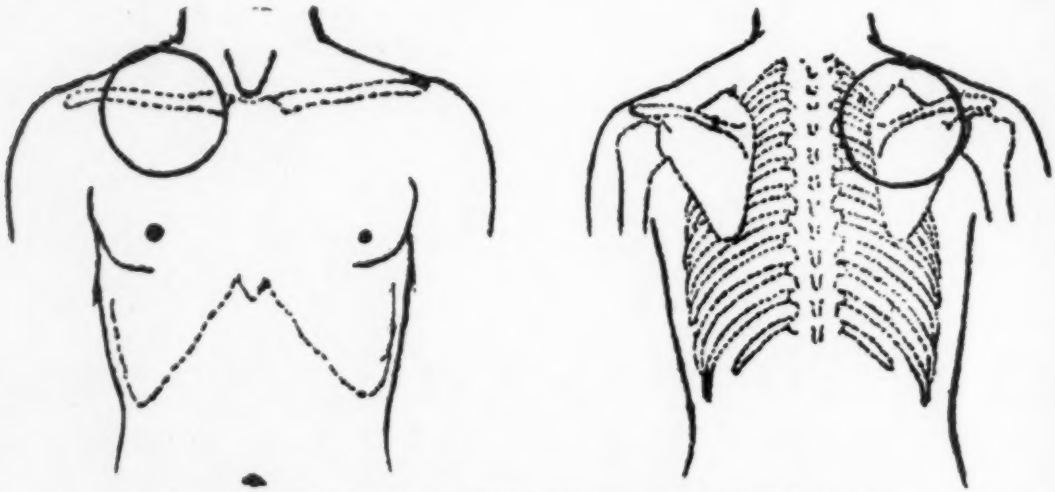

FIG. 1. Location of fields in radiation treatment of cancer of the lung.

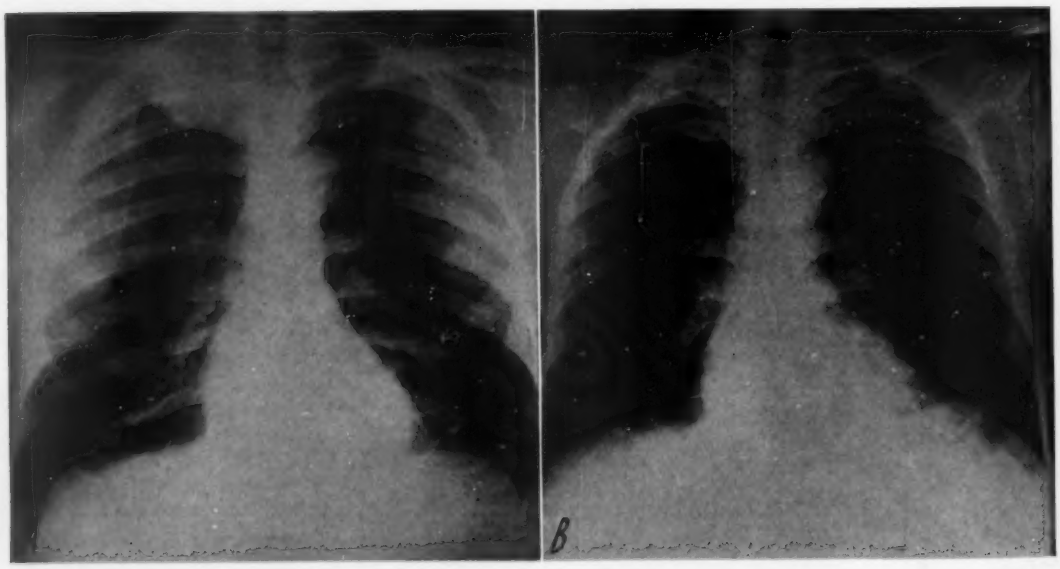


FIG. 2. Case 1. Cancer of the lung. *A*, roentgenogram of the chest taken before radiation treatment. *B*, roentgenogram of the chest taken fifteen months after completing treatment.

TABLE III

CANCER OF THE ESOPHAGUS

| Alive: 11 | | | |
|---|---|---|---|
| More than 2 yr. | More than 1 yr. | Between 12 and 6 mo. | Between 6 and 2½ mo. |
| 0 | 2 (N.E.D.) | 4 (N.E.D.) | 5 (2 with disease) (1 N.E.D.) (2 too soon after finishing treatment to be proved) |

| Dead: 47 | | | |
|---|---|---|---|
| After a period of more than 2 yr. | After a period of more than 1 yr. | Between 12 and 6 mo. | Between 3 mo. and 1 day |
| 1 | 2 | 17 | 27 |

was somewhat inflamed, no ulceration could be seen. There was an excellent regression of the tumor from the therapy. The lumen appeared adequate.

During the course of treatment, both the lung and esophagus cancers were observed by endoscopic methods.

### GASTRIC CANCER

Of the 28 patients treated for gastric cancer, 2 are alive, 21 are dead, and 5 have been lost of track of.

The survival rate is shown in Table IV.

No patient in this group was classified as "primary operable," and then irradiated instead of receiving surgery.

The 2 living patients have recurrent disease.

Of the 21 patients who died, 19 had an exploratory laparotomy done which showed that 7 had proved metastases to the liver, pancreas, peritoneum or omentum; that 9 must be considered inoperable without giving detailed reasons; and that 3, with recurrent disease, were inoperable. This leaves only 2 that were called inoperable by roentgen and clinical studies alone.

It is evident, therefore, that the results from this group furnish little evidence of the possibilities of million volt therapy in the treatment of gastric cancer.

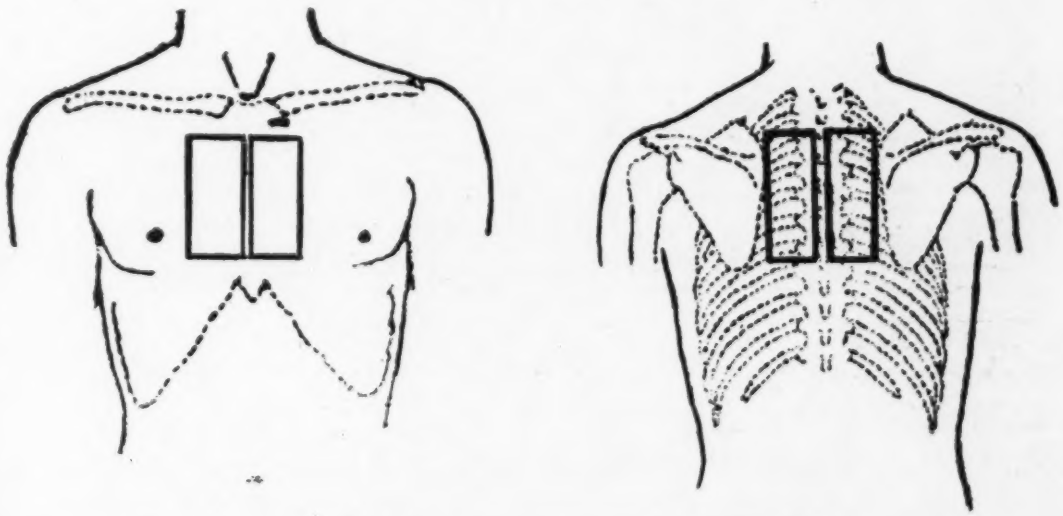

FIG. 3. Location of fields in radiation treatment of cancer of the esophagus.

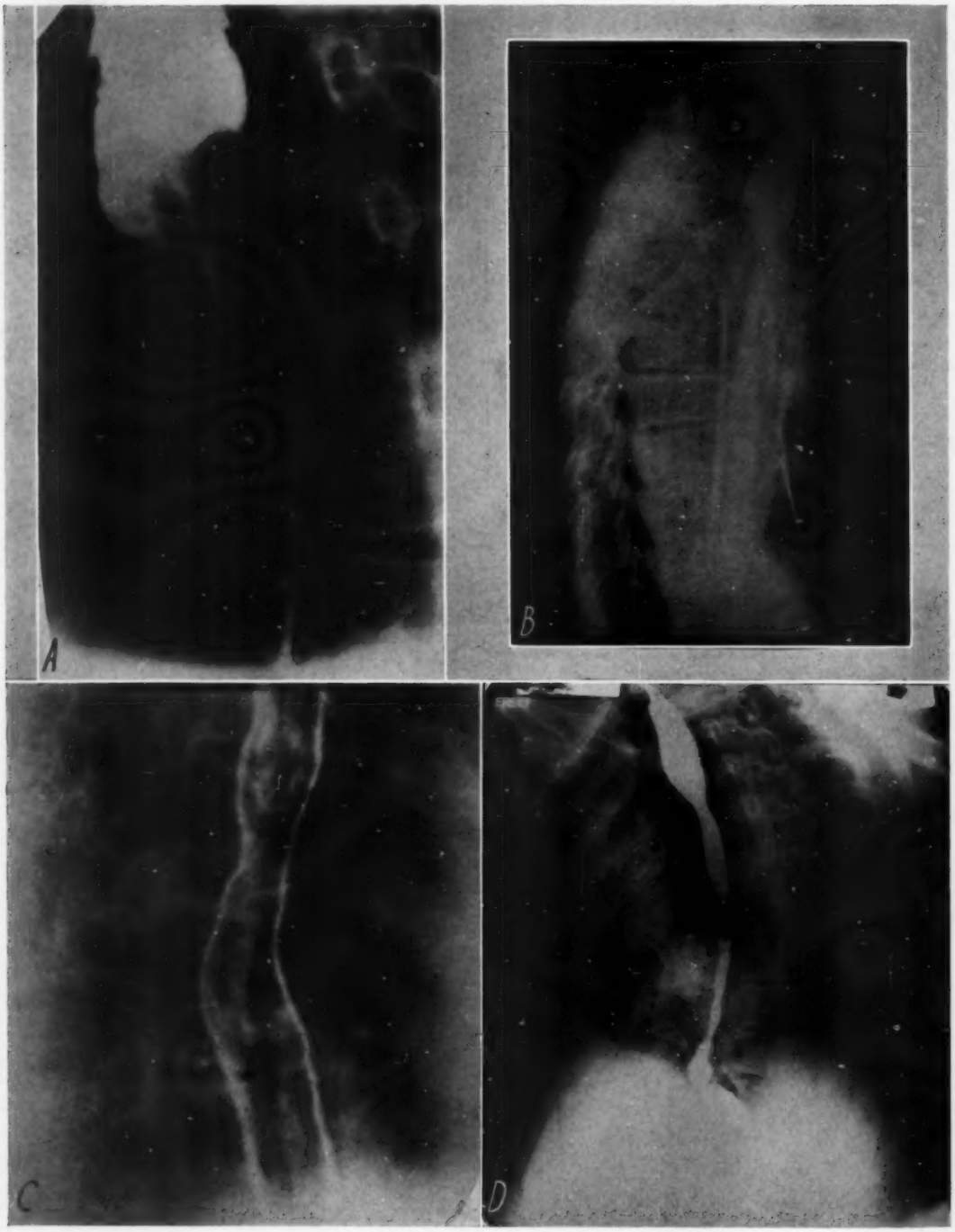


FIG. 4. Case II. Cancer of the esophagus. *A* and *B*, roentgenograms of the esophagus taken before radiation treatment. *C* and *D*, roentgenograms of the esophagus taken nine months after completing treatment.

### CANCER OF THE BLADDER

Of the 25 patients treated for cancer of the bladder, 7 are alive, 16 are dead, and 2 have been lost track of.

The survival rate is shown in Table V.

It has been our experience in the radiation therapy of bladder cancer with either 200,000 or 1,000,000 volts, that if the tumor

TABLE IV

GASTRIC CANCER

| Alive: 2 | | | | |
|---|---|---|---|---|
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 3 mo. | Between 3 and 1 mo. |
| — | — | — | 2 | — |
| **Dead: 21** | | | | |
| After a period of more than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 6 mo. | Between 6 mo. and 2 wk. |
| — | — | — | 4 | 17 |

is infected and the patient has urgency and frequency of urination, roentgen therapy affects the patient in one of two ways: either the symptoms subside rapidly during the first treatments, indicating a favorable response; or the symptoms increase, often to the point where irradiation has to be discontinued. If the patient is affected seriously by the treatment, the symptoms appear to be increased earlier and with greater severity when the higher voltage is used. This may be due to the greater depth dose.

CASE III. *Diagnosis:* Cancer of the bladder.

*Histopathological Diagnosis:* Papillary carcinoma.

The cystoscopic report before the treatment was as follows: The cystoscope reveals a large papillary, fungating lesion which involves most of the neck of the bladder. It appears to be an extremely extensive neoplasm.

*Treatment:* The patient was treated through five fields, one anterior, two lateral and two posterior, each field being 14 by 11.5 cm. The daily dose was 300 r to each field. The total dose was 3,000 r to the anterior and posterior fields and 3,600 r to the lateral fields. The tumor dose was 6,060 r.

*Subsequent Course:* The patient is in excellent health with no bladder symptoms. The cystoscopy one year and nine months after the treatments were finished showed only "scarring" in the vault. There was no evidence of recurrence.

### CANCER OF THE PROSTATE

Patients with cancer of the prostate are often treated at Memorial Hospital with stilbestrol, omitting irradiation. This ac-

TABLE V

CANCER OF THE BLADDER

| Alive: 7 | | | | |
|---|---|---|---|---|
| Three yr. | More than 2 yr. | More than 1 yr. | Between 12 and 6 mo. | Between 6 and 3 mo. |
| 1 (N.E.D.) | 2 (N.E.D.) | 1 (N.E.D.) | 1 small recurrence; treated with gold radon seeds | 2 (N.E.D.) |
| **Dead: 16** | | | | |
| — | — | 3 | 4 | 9 (1 patient died of pneumonia) |

TABLE VI

CANCER OF THE PROSTATE

| Alive: 7 | | | | |
|---|---|---|---|---|
| 3 yr. | More than 2 yr. | 2 yr. | More than 1 yr. | Less than 1 yr. |
| 1 (N.E.D.) | 3 (1 N.E.D.) (2 some recurrent disease) Bilateral orchidectomy recently | 1 (N.E.D.) Stilbestrol since treatment | 2 (1 No evidence of active disease, stilbestrol also) (1 with disease) | — |
| Dead: 8 | | | | |
| — | — | — | — | 8 (1 committed suicide) |

counts for the small number treated by the 1,000,000 volt unit.

Orchidectomy and stilbestrol are well known and many are enthusiastic over this new method of treating cancer of the prostate. For this reason roentgen therapy is neglected. This is a mistake, for irradiation is a valuable adjunct in the treatment, especially when bone metastases are present.

Of the 17 patients treated for cancer of the prostate, 7 are alive, 8 are dead, and 2 have been lost track of.

The survival rate is shown in Table VI.

The patients in this group were treated

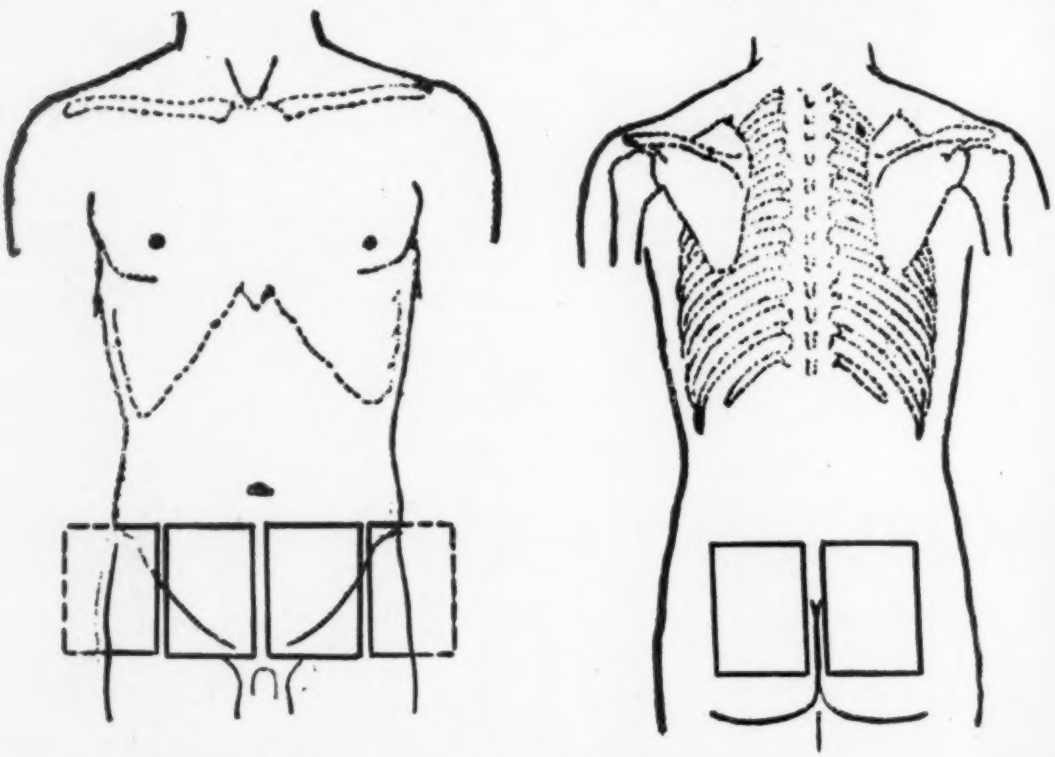

FIG. 5. Location of fields in radiation treatment of cancer of the prostate.

through six or seven fields, two anterior, two posterior, two lateral and some with a perineal field. The daily dose was usually 300 r to one field. The total dose was 3,000 r to each of the fields (Fig. 5).

Case iv. *Diagnosis:* Cancer of the prostate.

*Histopathological Diagnosis:* Cancer of the prostate. The prostate was enlarged, irregular, and stony hard.

*Treatment:* The patient was given 3,300 r to each of the two anterior fields, 3,300 r to each of the two posterior fields and 2,100 r to each of the two lateral fields. In addition, 2,100 r was given through a perineal field. The tumor dose was 7,120 r.

*Subsequent Course:* The patient is in excellent condition three years after completion of treatment. He is working steadily and shows no evidence of disease. The rectal examination revealed a rather elastic prostate not at all typical of active disease.

### CANCER OF THE RECTUM

Of the 17 patients treated for cancer of the rectum, 6 are alive and 11 are dead.

The survival rate is shown in Table vii.

dose was between 300 and 400 r per field with a total dose of 3,000 to 3,600 r per field.

Case v. *Diagnosis:* Cancer of the rectum.

*Histopathological Diagnosis:* Adenocarcinoma. The rectal examination revealed a large fixed angular carcinoma beginning 1 cm. from the skin margin. The lumen was greatly narrowed.

*Treatment:* The patient was treated in the manner explained above, with a total tumor dose of 7,150 r.

*Subsequent Course:* The patient is in good general condition and today, one year and nine months after finishing the treatments, shows no evidence of disease. The lumen is sufficient for evacuation.

Not much can be reported on the other cases of this group. Although as a rule rectal cancer does not respond completely to roentgen therapy, yet here are 3 cases that show at least a very good regression of the disease. Two of these were inoperable at the time the treatments began and the other one, while operable as far as the local lesion was concerned, was inoperable because of the patient's advanced years.

Table VII

CANCER OF THE RECTUM

Alive: 6

| More than 2 yr. | 2 yr. | More than 1 yr. | 1 yr. | Between 10 and 12 mo. |
|---|---|---|---|---|
| 1<br>N.E.D. | — | 3<br>(1 No evidence of active disease)<br>(2 with disease) | — | 2<br>with disease |

Dead: 11

| More than 2 yr. | 2 yr. | More than 1 yr. | 1 yr. | Between 12 and 3 mo. |
|---|---|---|---|---|
| — | — | 3<br>(1 had ovarian cancer and died of this) | — | 8 |

The arrangement of the fields in patients with cancer of the rectum is similar to that in patients with cancer of the bladder or prostate. Six pelvic fields, about 14 by 11 cm. in size, were generally used. The daily

### CANCER OF THE CERVIX AND VAGINA

Of the 17 patients treated for cancer of the cervix and vagina, 3 are alive, 10 are dead, and 4 have been lost track of.

The survival rate is shown in Table viii.

TABLE VIII

CANCER OF THE CERVIX AND VAGINA

| Alive: 3 | | | | |
|---|---|---|---|---|
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 4 mo. | Less than 4 mo. |
| — | — | — | 3 | — |
| **Dead: 10** | | | | |
| — | 1 | 4 | 5 | — |

It is significant that of this group only 2 patients had not been thoroughly treated previously by surgery, roentgen rays, radium or all three; and that 11 of the 17 were definitely unsuitable on first examination for judging the effectiveness of million volt therapy.

Since nearly all of the patients in this group had received previous roentgen irradiation a fixed plan of treatment could not be followed. Whenever it was possible the patient was treated through six pelvic fields. The total dose was approximately 2,600 r to each field. The previous treatments made it impossible to give a higher total dose; it was often lower.

### CANCER OF THE OVARY

Of the 13 patients treated for cancer of the ovary, 3 are alive and 10 are dead.

The survival rate is shown in Table IX.

Eight of the 13 patients in this group were, on first examination, considered as unsuitable. All in the group had received previous surgery or roentgen treatments.

For the past three months all patients with ovarian cancer have been treated by the 1,000,000 volt machine. It is too early to give any report of them. The patient is treated through four pelvic and four abdominal fields with an average of 200 r to two fields daily and a total dose of 3,000 r to each field.

### BONE SARCOMA

Of the 9 cases with bone sarcoma 3 are alive, 5 are dead, and 1 has been lost track of.

The survival rate is shown in Table X.

On 2 of these patients, amputation was performed after completion of irradiation.

TABLE IX

CANCER OF THE OVARY

| Alive: 3 | | | | |
|---|---|---|---|---|
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 8 mo. | Less than 8 mo. |
| — | — | 1<br>with disease | 2<br>(1 N.E.D.)<br>(1 with disease) | — |
| **Dead: 10** | | | | |
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 8 mo. | Between 8 and 2 mo. |
| — | 2 | 1 | 2 | 5 |

TABLE X

BONE SARCOMA

| Alive: 3 | | | | |
|---|---|---|---|---|
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 6 mo. | Less than 6 mo. |
| 1 (N.E.D.) | — | — | 2 (No evidence of active disease) | — |
| **Dead: 5** | | | | |
| More than 2 yr. | 2 yr. | More than 1 yr. | Between 12 and 6 mo. | 5 mo. |
| — | — | — | 3 | 1 |

In one, a Ewing's sarcoma, there was no microscopic evidence of residual disease although the original biopsy was positive; in the other, an osteogenic sarcoma, a microscopic examination revealed marked irradiation effects.

## SUMMARY AND CONCLUSION

The results of the treatments, as shown in Table XI, are at first glance discouraging. Of a total of 315 patients, 213 are dead.

However, the disease was so advanced in 145 patients that palliation was all that could be expected. If we subtract these 145 unsuitable cases from the 315, only 170 remain. Even many of this group presented more complicated problems than does the usual patient admitted for radiation therapy. Some had already been treated up to the skin tolerance by the 200,000 volt unit, some were so sensitive to irradiation that it was only after their treatments by the 200,000 volt unit had been interrupted several times that they were referred for treatment with the higher unit; and some were so sick that the course of treatments had to be stopped before a satisfactory amount of radiation was given.

TABLE XI

A SURVEY OF THE PATIENTS TREATED

| Diagnosis | Number of Cases | Previous Treatment | Pathological Condition Unproved | Dead | Alive | Result Unknown |
|---|---|---|---|---|---|---|
| Cancer of lung | 93 | 19 | 7 | 68 | 21 | 4 |
| Cancer of esophagus | 62 | 15 | 3 | 47 | 11 | 4 |
| Cancer of stomach | 29 | 12 | 5 | 21 | 2 | 6 |
| Cancer of bladder | 25 | 9 | 3 | 16 | 7 | 2 |
| Cancer of prostate | 17 | 7 | 3 | 8 | 7 | 2 |
| Cancer of rectum | 17 | 4 | 3 | 11 | 6 | 0 |
| Cancer of cervix | 14 | 12 | 1 | 8 | 3 | 3 |
| Cancer of vagina | 3 | 3 | 0 | 2 | 0 | 1 |
| Cancer of ovary | 13 | 13 | 0 | 10 | 3 | 0 |
| Bone sarcoma | 9 | 2 | 1 | 5 | 3 | 1 |
| Miscellaneous | 33 | 23 | 6 | 17 | 8 | 8 |
| Total | 315 | 119 | 32 | 213 | 71 | 31 |

Moreover, the million volt therapy probably resulted in palliation for many patients over a period of months and even years before they died.

Physical measurements show that at greater depth the higher voltage does deliver a larger dose than is possible with the lower unit. Moreover, when small fields are used the increased depth dose becomes even greater since there is little scattered radiation. This advantage is lessened when the cross-fire technique is used with the higher voltage unit. The dose on the surface of exit somewhat offsets the practical value of the greater depth dose.

The million volt unit, however, does permit the use of a small field. This is an apparent advantage, for in the clinical application of roentgen radiation a field should be used that will include the tumor in its entirety with as little of the surrounding normal tissue as possible. Another advantage is the relatively greater depth dose in the smaller fields in comparison to the 200,000 volt machine.

The present analysis would seem to indicate, however, that the million volt machine is not a substitute for the 200,000 volt unit; that its use is limited to the treatment of deep-seated tumors.

But at a depth of 7 or 8 cm., the lower voltage unit gives nearly as great a dose as the higher voltage unit, and since the former is a more flexible machine it is better to use it in the treatment of tumors within that range. On the other hand, in the treatment of deep-seated tumors, especially those near vital organs, the higher voltage unit is better.

It will be interesting at some later date to study the results of treatments given by the million volt machine to patients who were not in such an advanced stage of disease and thus more suitable for judging the results of roentgen therapy.

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# THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Twenty-eighth Annual Meeting: 1944, to be announced.

# EDITORIAL

## ROENTGENOLOGICAL PROBLEMS, PAST AND FUTURE

RECENTLY Barclay,* in an address before the Faculty of Radiologists, in reviewing a number of the pitfalls in the history of roentgenological diagnosis, analyzed some of the lessons which have been learned over these many years and with prophetic vision pointed out a road to the future. No one is perhaps better equipped than Barclay as he has stood at the forefront of his profession from the beginning of his interest in roentgenologic work. He can therefore with some feeling point to the mistakes in roentgenologic practice which have caused setbacks and lost ground which has been recovered only by the subsequent great contributions to medicine which have been brought about through roentgen-ray studies.

In his reminiscences, Barclay recalls that from its very beginning the roentgen ray was used as a method of study of the pathologic and as a result the roentgenologist was always looking for the abnormal, failing to appreciate to the fullest extent that he was also observing the normal. His well grounded teachings in morbid anatomy gave the roentgenologist fixed ideas and when he actually saw living anatomy as demonstrated by the roentgen ray he, in his early work, assumed that these findings must be abnormal. The introduction of the opaque meal method of examination of the alimentary tract coincided with the decline in popularity of Glénard's disease or splanchnoptosis, a diagnosis which had been very much in vogue for a number of years. The roentgenologic method of study revived interest in this condition and quite naturally the roentgenologist was called into consultation and, lacking a knowledge of the variations in the normal, he quite easily fell into the unsuspecting mistake of interpreting the normal as being abnormal and undoubtedly contributed unwittingly to the tremendous vogue which splanchnoptosis had for a number of years, and wittingly or not, was a party to the surgical vogue of the times. As some one has expressed it, everything that was fixed in the abdomen the surgeon loosed and all that was loosed he fixed.

Little did the roentgenologist at the time realize there were certain normal patterns for individuals of different habitus and it was the work of Barclay that contributed so much to the elucidation of such observations. His studies of the gastrointestinal tract are epoch making in that respect and it was through the efforts of such men as Barclay that roentgenologists finally passed from the stage of having a fixed idea from the traditional teaching of anatomy as regards the position of the abdominal viscera.

Roentgenologists attempted to find out for themselves the anatomy of the normal but in order to do this the studies had to be carried out in the course of their routine work on patients who were considered to be normal, and such other normal subjects as would collaborate. Barclay points out feelingly that if anatomists had only appreciated the potential value of roentgenologic methods and at once applied them to the anatomical study of the viscera in the normal, living subject, this dark period of uncertainty regarding the normal anatomy of the gastrointestinal tract would have quickly ended.

The schools of physiology were also remiss in their full appreciation of the value of roentgenology as an aid in studying the gastrointestinal tract. The physiological teaching at that time suggested that the alimentary tract was a tube, almost a test tube, in which certain definite actions and movements took place. The idea was even propagated that everything should work according to a fixed schedule and should

* Barclay, A. E. Radiology—empiricism or science? *Brit. J. Radiol.*, November, 1943, *16*, 344–347.

this schedule by any chance not be adhered to, stasis would occur and various toxic products would be absorbed, and many of the patient's symptoms were explained on this ground. As a result of such teaching, constipation, Barclay says, became the bogey of the day and there was ushered in a period in which stasis in the gastrointestinal tract was considered the causative factor of many ills of everyday life, particularly arthritic conditions. There were certain areas that were commonly thought to be particularly prone to stasis, namely the terminal ileum, the cecum and various parts of the large intestine, and again the roentgenologist being unfamiliar with the normal, quite easily fell into this conception of stasis.

Not only was the early roentgenologist led astray in the interpretation of the gastrointestinal tract but also in the studies of the chest. The poor quality of the roentgenograms in the beginning of the roentgen methods of study possibly contributed no little to the errors which trapped the roentgenologist. In addition, few roentgenologists having had the opportunity to study the normal misinterpreted the shadows at the roots of the lung which stood out so prominently, mistaking them for enlarged lymph nodes caused from living in the dusty streets of the city, or lymph nodes of tuberculous origin, whereas in fact, as we know now, these were merely the normal vascular markings of the roots of the lungs. With each improvement in the technique there was an added burden of the interpretation of the normal lung structure and, as Barclay points out, "a shadow is not an entity in itself and has no characteristics of its own. It is merely the image of some object which lies between it and the source of the rays." Thus the recognition and interpretation of such structures depends entirely on a knowledge of the features of the structures themselves.

To the roentgenologist who is well acquainted with the normal anatomy of the lungs, the wealth of detail provided in good chest roentgenograms of today proves of great value but to the inexpert it may equally prove a stumbling block in that he may read into the normal structures pathological conditions.

With each advancement in the technical procedures of roentgenology there is an added burden placed on the roentgenologist. How may we meet this advance? It is a well known fact that practically no or very little roentgenological instruction is now included in the teaching of anatomy. While every first class hospital has an adequate department of roentgenology there is practically no school of anatomy which uses the roentgen ray in its courses of instruction, and the physiological departments in the various universities are completely lacking in roentgenological equipment for teaching the students the normal physiological movements of the gastrointestinal tract, to say nothing of the wealth of detail that might be taught concerning the physiology of the lungs by the use of the roentgen ray.

Barclay, with prophetic vision, points to the need of well equipped research departments in the universities closely allied with the departments of anatomy, physiology and clinical medicine, having access also to the department of radiology of the hospital. Such research institutes, in his opinion, should be staffed by men with clinical experience in roentgenologic work. Such men with sufficiently endowed institutes could add enormously to our knowledge of the normal and perhaps could advance medicine more rapidly by such research on the normal. The necessity for such an institute is the more important as the result of the introduction of mass miniature roentgenography and the enthusiasm with which it has been received both by the profession and by the laity. As is pointed out in Barclay's discussion, the roentgenologist in such mass survey work is interpreting the normal and the diagnosis of health is infinitely more difficult and more important than that of disease.

The need for such a research institute can scarcely be doubted. What school or university will seize the opportunity to establish itself in the vanguard of such epoch-making studies?

# SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

*Items for this section solicited promptly after the events to which they refer.*

## MEETINGS OF ROENTGEN SOCIETIES*

### UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
*Secretary*, Dr. H. Dabney Kerr, University Hospital, Iowa City, Iowa. Annual meeting: To be announced.

AMERICAN COLLEGE OF RADIOLOGY
*Secretary*, Mac F. Cahal, 540 N. Michigan Ave., Chicago, Ill.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
*Secretary*, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: 1944, to be announced.

ARKANSAS RADIOLOGICAL SOCIETY
*Secretary*, Dr. J. S. Wilson, Mack Wilson Hospital, Monticello, Ark. Meets every three months and also at time and place of State Medical Association.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
*Secretary*, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N. Y. Annual meeting: 1944, to be announced.

RADIOLOGICAL SECTION, BALTIMORE MEDICAL SOCIETY
*Secretary*, Dr. Walter L. Kilby, Baltimore. Meets third Tuesday each month, September to May.

SECTION ON RADIOLOGY, CALIFORNIA MEDICAL ASSOCIATION
*Secretary*, Dr. J. D. Coate, 434 Thirtieth St., Oakland, Calif.

RADIOLOGICAL SECTION, CONNECTICUT MEDICAL SOCIETY
*Secretary*, Dr. Max Climan, 242 Trumbull St., Hartford, Conn. Meets bi-monthly on second Thursday, at place selected by Secretary. Annual meeting in May.

SECTION ON RADIOLOGY, ILLINOIS STATE MEDICAL SOCIETY
*Secretary*, Dr. H. W. Ackemann, 321 W. State St., Rockford, Ill.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL ASSOCIATION
*Secretary*, Dr. Donald R. Laing, 65 North Madison Ave., Pasadena, Calif. Meets on second Wednesday of each month at the County Society Building.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
*Secretary*, Dr. Roy G. Giles, Temple, Texas.

BROOKLYN ROENTGEN RAY SOCIETY
*Secretary*, Dr. Leo Harrington, 880 Ocean Ave., Brooklyn, N.Y. Meets monthly on fourth Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
*Secretary*, Dr. Joseph S. Gian-Francheschi, 610 Niagara St., Buffalo, N. Y. Meets second Monday of each month except during summer months.

CHICAGO ROENTGEN SOCIETY
*Secretary*, Dr. Warren W. Furey, 6844 S. Oglesby Ave., Chicago, Ill. Meets second Thursday of each month October to April inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
*Secretary*, Dr. Samuel Brown, 707 Race St., Cincinnati, Ohio. Meets third Tuesday of each month, October to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
*Secretary*, Dr. D. D. Brannan, 11311 Shaker Blvd., Cleveland 4, Ohio. Meets at 6:30 P.M. at Allerton Hotel on fourth Monday each month, October to April, inclusive.

DALLAS-FORT WORTH ROENTGEN STUDY CLUB
*Secretary*, Dr. X. R. Hyde, Medical Arts Bldg., Fort Worth, Texas. Meetings held in Dallas on odd months and in Fort Worth on even months, on third Monday, at 7:30 P.M.

DENVER RADIOLOGICAL CLUB
*Secretary*, Dr. Edward J. Meister, 366 Metropolitan Bldg., Denver, Colo. Meets third Friday of each month at Denver Athletic Club.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
*Secretary*, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne County Building.

FLORIDA RADIOLOGICAL SOCIETY
*Acting Secretary*, Dr. Walter A. Weed, 204 Exchange Bldg., Orlando, Fla. Meetings in May and November.

GEORGIA RADIOLOGICAL SOCIETY
*Secretary*, Dr. James J. Clark, 478 Peachtree St., Atlanta, Ga. Meets in November and at annual meeting of Medical Association of Georgia in the spring.

RADIOLOGICAL SOCIETY OF KANSAS CITY
*Secretary*, Dr. Arthur B. Smith, 800 Argyle Bldg., Kansas City, Mo. Meets third Thursday of each month at a place designated by the president.

ILLINOIS RADIOLOGICAL SOCIETY
*Secretary*, Dr. Wm. DeHollander, St. John's Hospital, Springfield, Ill. Meets three times a year.

INDIANA ROENTGEN SOCIETY
*Secretary*, Dr. H. C. Ochsner, Methodist Hospital, Indianapolis. Meeting held the second Sunday in May annually.

KENTUCKY RADIOLOGICAL SOCIETY
*Secretary*, Dr. W. C. Martin, 321 W. Broadway, Louisville. Meets annually in Louisville on first Saturday in Apr.

LONG ISLAND RADIOLOGICAL SOCIETY
*Secretary*, Dr. Marcus Wiener, 1430-48th St., Brooklyn, N. Y. Meets Kings County Med. Soc. Bldg. monthly on fourth Thursday, October to May, 8:30 P.M.

LOUISIANA RADIOLOGICAL SOCIETY
*Secretary*, Dr. J. R. Anderson, 1130 Louisiana Ave., Shreveport. Meets annually during Louisiana State Medical Society Meeting.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
*Secretary*, Dr. E. M. Shebesta, 1429 David Whitney Bldg., Detroit. Three meetings a year, Fall, Winter, Spring.

MILWAUKEE ROENTGEN RAY SOCIETY
*Secretary*, Dr. C. A. H. Fortier, 231 W. Wisconsin Ave., Milwaukee, Wis. Meets monthly on second Monday at University Club.

MINNESOTA RADIOLOGICAL SOCIETY
*Secretary*, Dr. Annette T. Stenstrom, 1218 Medical Arts Bldg., Minneapolis, Minn. One meeting a year at time of Minnesota State Medical Association.

NEBRASKA RADIOLOGICAL SOCIETY
*Secretary*, Dr. D. A. Dowell, Medical Arts Bldg., Omaha, Nebr. Meets third Wednesday of each month, at 6 P.M. at either Omaha or Lincoln.

NEW ENGLAND ROENTGEN RAY SOCIETY
*Secretary*, Dr. Hugh F. Hare, Lahey Clinic, Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

RADIOLOGICAL SOCIETY OF NEW JERSEY
*Secretary*, Dr. H. J. Perlberg, 921 Bergen Ave., Jersey City. Meets annually at time and place of State Medical Society. Mid-year meetings at place chosen by president.

NEW YORK ROENTGEN SOCIETY
*Secretary*, Dr. Ramsay Spillman, 115 East 61st St., New York City. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
*Secretary*, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

NORTH DAKOTA RADIOLOGICAL SOCIETY
*Secretary*, Dr. L. A. Nash, St. John's Hospital, Fargo. Meetings held by announcement.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Central New York Roentgen Ray Society
*Secretary*, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse. Three meetings a year. January, May, November.

Ohio Radiological Society
*Secretary*, Dr. J. E. McCarthy, 707 Race St., Cincinnati. Meets at time and place of annual meeting of Ohio State Medical Association.

Pacific Roentgen Society
*Secretary*, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association.

Pennsylvania Radiological Society
*Secretary*, Dr. L. E. Wurster, 416 Pine St., Williamsport.

Philadelphia Roentgen Ray Society
*Secretary*, Dr. R. P. Barden, University Hospital, Meetings first Thursday of each month from October to May inclusive at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

Pittsburgh Roentgen Society
*Secretary*, Dr. R. G. Alley, 4800 Friendship Ave. Meets second Wednesday each month, 4:30 P.M., October to June, Pittsburgh Academy of Medicine.

Rochester Roentgen Ray Society, Rochester, N. Y.
*Secretary*, Dr. Sidney Larson, Strong Memorial Hospital. Meets monthly on third Monday from October to May, inclusive, 8 P.M. at Strong Memorial Hospital.

Rocky Mountain Radiological Society
*Secretary*, Dr. A. M. Popma, 220 N. First St., Boise, Idaho.

St. Louis Society of Radiologists
*Secretary*, Dr. P. C. Schnoebelen, 462 N. Taylor Ave. Meets fourth Wednesday of each month, except June, July, August, and September, at a place designated by the president.

San Francisco Radiological Society
*Secretary*, Dr. H. A. Hill, 450 Sutter St., San Francisco. Meets monthly on third Thursday at 7:45 P.M., first six months at Toland Hall, second at Lane Hall.

Shreveport Radiological Club
*Secretary*, Dr. R. W. Cooper, Charity Hospital, Shreveport, La. Meets monthly on third Wednesday, at 7:30 P.M., September to May inclusive.

South Carolina X-Ray Society
*Secretary*, Dr. T. A. Pitts, Baptist Hospital, Columbia, S. C. Meets in Charleston on first Thursday in November, also at the time and place of South Carolina State Medical Association.

Tennessee Radiological Society
*Secretary*, Dr. J. M. Frère, 707 Walnut St., Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
*Secretary*, Dr. Herman Klapproth, Sherman, Texas.

University of Michigan Department of Roentgenology Staff Meeting
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Radiological Conference
*Secretary*, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis. Meets every Thursday from 4:00–5:00 P.M., Room 301, Service Memorial Institute.

Virginia Radiological Society
*Secretary*, Dr. E. L. Flanagan, 116 E. Franklin St., Richmond, Va. Meets annually in October.

Washington State Radiological Society
*Secretary*, Dr. Thomas Carlile, 1115 Terry St., Seattle. Meets fourth Monday each month, October throughMay, College Club, Seattle.

X-ray Study Club of San Francisco
*Secretary*, Dr. J. M. Robinson, University of California Hospital. Meets monthly in evening on third Thursday.

### Cuba

Sociedad de Radiología y Fisioterapia de Cuba
*President*, Dr. J. Manuel Viamonte, Hospital Mercedes, Habana, Cuba. Meets monthly in Habana.

### British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Medical Members' meeting held monthly on third Friday at 2:30 P.M. and Ordinary Meeting at same time on following Saturday, October to May, 32 Welbeck St., London, W.1.

Section of Radiology of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month at 4:45 P.M. at the Royal Society of Medicine 1, Wimpole St., London, W. 1.

Faculty of Radiologists
*Secretary*, Dr. M. H. Jupe, 32 Welbeck St., London, W. 1 England.

Section of Radiology and Medical Electricity, Australasian Medical Congress
*Secretary*, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
*Secretary*, Dr. Keith Hallam, St. George's Hospital, K.E.W., Melbourne, E. 4, Victoria, Australia. Meets monthly from March to November inclusive.

Canadian Association of Radiologists
*Secretary*, Dr. A. D. Irvine, 540 Tegler Bldg., Edmonton, Alberta.

Section of Radiology, Canadian Medical Association
*Secretary*, Dr. C. M. Jones, Inglis St., Ext. Halifax, N. S.

Radiological Section, New Zealand British Medical Association
*Secretary*, Dr. Colin Anderson, Invercargill, New Zealand. Meets annually.

### South America

Sociedad Argentina de Radiologia
*Secretary*, Dr. Guido Gotta, Buenos Aires, Argentina. Meetings are held monthly.

### Continental Europe

Sociedad Espanola de Radiologia y Electrologia
*Secretary*, Dr. J. Martin-Crespo, Fuencarral, 7. Madrid, Spain. Meets monthly in Madrid.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
*Secretary* for French language, Dr. A. Grosjean La Chaux de Fonds.
*Secretary* for German language, Dr. Scheurer, Molzgasse Biel. Meets annually in different cities.

Societatea Romana de Radiologie si Electrologie
*Secretary*, Dr. Oscar Meller, Str. Banul Mărăcine, 30, S. I., Bucuresti, Roumania. Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad: USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
*Secretaries*, Drs. S. A. Reinberg and S. G. Simonson. Meets annually.

Leningrad Roentgen Ray Society
*Secretaries*, Drs. S. G. Simonson and G. A. Gusterin. Meets monthly, first Monday at 8 o'clock, State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
*Secretaries*, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky. Meets monthly, first Monday, 8 P.M.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association.

# DEPARTMENT OF TECHNIQUE

*Department Editor:* ROBERT B. TAFT, M.D., B.S., M.A., 103 Rutledge Ave.
Charleston, S. C.

## A SIMPLE TECHNIQUE FOR CARDIAC MENSURATION*

*By* S. T. HERSTONE, M.D.
*Instructor in Radiology and Anatomy, New York University College of Medicine*
*and*
D. E. ZION, M.D.
*Resident in Roentgen Diagnosis, Montefiore Hospital*
NEW YORK, NEW YORK

ORTHODIAGRAPHY has been recognized for many years as the most accurate method of determining cardiac measurements. Despite this fact, it has not been used extensively because of several important disadvantages.

1. To trace the heart contour accurately by means of orthodiagraphy takes a period of ten to twenty minutes. In doing large series of cases this becomes extremely tedious and time consuming.

2. The patient's exposure to the roentgen ray is considerable and if oblique tracings are attempted the radiation dosage may become prohibitive.

The purpose of this paper is to describe a simple method of obtaining an orthodiagram with the elimination of these objections.

### METHOD

The necessary equipment consists of a standard roentgenoscope, film, and a 10 by 12 inch cassette. The horizontal shutter of the roentgenoscope diaphragm is opened to the fullest extent. The vertical shutter is narrowed to a slit 1 cm. or less in diameter. The patient is placed with his back to the panel of the roentgenoscope so that the midline of the panel passes through the approximate center of his heart. The film is then placed immediately in front of the patient. It can be held by the patient, strapped to his chest or placed in a stand constructed for this purpose. The patient is told not to move and to breathe normally. The milliamperage is set at 4, and the kilovoltage at between 75 and 85, depending on the thickness of the chest wall. The up-and-down movement of the tube is fixed. The tube is then slowly and evenly moved from side to side, so that the narrow vertical beam emanating from it sweeps back and forth across the entire width of the chest. This movement is continued throughout the entire exposure which lasts approximately thirty seconds. In this way, the entire field is traversed about fifteen to twenty times. The film is then developed and a roentgenogram of the cardiac contour is obtained in which transverse measurements are as accurate as in the average orthodiagram.

The point of opposite pulsation on the left heart border can be identified by the use of a lead marker attached to the chest wall or to the center of the tube. If the latter method is used, a horizontal line will be seen passing through this point (Fig. 1).

### DISCUSSION

This procedure has certain advantages:

1. It is an accurate means for determining cardiac measurements. For transverse measurements of the heart, it compares favorably with orthodiagraphy, and teleroentgenography. It utilizes the principle

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of orthodiagraphy and at the same time eliminates the subjective factor. It is more accurate than the 1/20 second teleroentgenogram, since it is taken through all phases of respiration and all phases of the cardiac cycle. There is less enlargement because of the use of the central beam principle.

2. The method is simple and is not time consuming. With little experience, one can complete the procedure within a few minutes, thereby diminishing the amount of exposure both to the patient and to the roentgenologist.

3. As an adjunct to roentgenoscopy it is a simple and economical method for obtaining a permanent record. It requires only a single 10 by 12 inch cassette, a film and the developing material. It can be done with equipment which is considerably less expensive than that needed for taking teleroentgenograms.

The method has certain disadvantages:

1. The vertical measurements are distorted. However, if one is interested in obtaining a true vertical measurement a procedure similar to the above may be employed, but with the horizontal shutter narrowed to a slit and the scanning performed in the vertical plane.

2. This method gives us no information as to pathological conditions in the lungs nor abnormality of cardiac movement, and because of this it should only be used as an adjunct to roentgenoscopy.

FIG. 1. Roentgenogram taken by described technique.

SUMMARY

A simple method for obtaining a permanent record of the transverse cardiac measurements is described. This method makes use of the roentgenoscope, and compares favorably with the orthodiagram and the teleroentgenogram.

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# ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

## ROENTGEN DIAGNOSIS

### HEAD

Singleton, A. O. Tumors of the salivary glands, benign and locally malignant. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 569–572.

Salivary gland tumors are probably the most debatable of all tumors. They include:

(1) *Parotid Cysts.* These cysts may be congenital but they are usually secondary to chronic infection or duct obstruction. They may be symptomless but are usually marked by swelling of the gland with pain which is relieved when the ducts are opened. Treatment with roentgen irradiation is to be preferred to attempts to dissect out the cyst. If sufficient radiation is given, the gland atrophies and the cysts give no further trouble.

(2) *Mikulicz's Disease.* The name of Mikulicz's syndrome has been given to an enlargement of the salivary glands (particularly the parotid), and lacrimal glands associated with leukemia, tuberculosis, lymphosarcoma, and toxic conditions. However, the condition described by Mikulicz in 1888 was not accompanied by constitutional symptoms. There is an extensive deposit of small round cells which seem to compress or displace the glandular parenchyma. The condition is very rare, not serious, and treatment is unnecessary

(3) *Adenolymphoma* (*onkocytoma*). This is one of the rarest of tumors. It is composed of a lymphadenoid stroma with germinal centers with an epithelial structure in the form of tubular glands, cysts, and papillae. It occurs in older persons, is benign, encapsulated, and grows slowly. It is not usually intimately connected with the gland and may be easily removed.

(4) *Adenoma of the Salivary Gland.* This is one of the controversial tumors. Warren states, "Adenomas readily recognized as such are extremely rare in the salivary gland." If they do occur, it is in the parotid gland. They are always encapsulated and may be cystic or solid. The differential diagnosis between the adenoma and mixed tumor is not possible before operation.

(5) *Mixed Tumors.* These tumors are benign in that they rarely metastasize but malignant in that local recurrence is a predominating characteristic. The long interest in these tumors has been from the fact that the embryology and pathology are without a satisfactory explanation and also because the treatment of them is still unsolved in spite of persistent effort on the part of the pathologist, the surgeon, and recently the roentgenologist. McFarland has estimated that 93.6 per cent of these tumors occur in the parotid gland. Transformation into carcinoma or sarcoma is extremely rare. McFarland argues against the removal of mixed tumors when they are small, claiming that recurrences are more likely in the small tumors. This, however, has not been found to be true by the author and several other investigators.

(6) *Carcinoma of the Parotid Gland.* This is one of the most incurable of the malignant tumors. Even with the most radical surgery early in the course of its growth, only a very few cures are on record.—*Mary Frances Vastine.*

Lampe, I. Pseudo-adenomatous basal-cell carcinoma of the tongue (salivary gland tumor). *Radiology*, July, 1942, *39*, 54–61.

A case of pseudo-adenomatous basal-cell carcinoma that originated in a mixed salivary gland tumor at the base of the tongue is described. This is a relatively rare form of tumor of the tongue. The patient was a man fifty-seven years of age who was under observation and treatment for thirteen years beginning June 2, 1927. When last heard from he said he was feeling well though it had been four years since the development of pulmonary metastases. During the observation period cervical, pulmonary and bone metastases developed. Roentgen treatment reduced the size of the primary lesion and the cervical metastases disappeared. It also abolished the pain caused by the bone metastases. The lung metastases grew very slowly and caused no symptoms.

These malignant salivary gland tumors grow slowly and metastasize late. This case did not respond to initial radium treatments, doubtless because the dose was insufficient but the size of the primary lesion decreased markedly in re-

sponse to fractional roentgen therapy with a dose of moderate intensity (2,600 r, measured in air, to each of two fields over a period of a month).—*Audrey G. Morgan.*

NECK AND CHEST

MACDONALD, IAN. Mammary carcinoma. *Surg., Gynec. & Obst.*, Jan., 1942, *74*, 75–82.

The records of 2,636 cases of mammary carcinoma (1,511 five year cures and 1,125 recurrent cases) have been reviewed by the author:

*Age.* The age of patients with mammary carcinoma does not have the prognostic significance with which it is commonly accredited. Excluding the cases of "inflammatory" carcinoma and those occurring in gravid and puerperal women, carcinoma of the breast at any early age merits as radical an approach with as much chance of cure as in older women. The best results are obtained in those patients who are thirty-five to fifty years of age and the least favorable results are seen in the decade from fifty to sixty.

*Heredity.* There is evidence of an inherited susceptibility to cancer in approximately 20 per cent of this series. Among the relatives of those women having a hereditary background of cancer, there is an excess of breast cancer at least three times greater than in the general population.

*Fertility.* Nulliparas are more prone to develop cancer of the breast than women who have had children, but once developed, the prognosis is as good, or perhaps better, for the nulliparous woman. The number of children borne by parous women has little or no influence on prognosis.

*Lactation.* The most consistent apparent factor in the genesis of mammary cancer is the failure of the breast to perform its expected physiological function. A full period of lactation in childbearing women seems to offer a degree of protection against subsequent development of breast cancer.

*Treatment.* Early treatment is of utmost importance in the cure of certain early lesions predestined otherwise to undergo rapid growth and early dissemination. In general, however, end-results are determined more by natural selection than by early treatment. Tumors of long duration in themselves are no contraindication to radical treatment, for 25 per cent of the five year cures here recorded were treated more than one year after recognition of the tumor.

To deny patients with otherwise operable neoplasms the chance of radical treatment because of the presence of axillary node metastases is to face the possible loss of 40 per cent of attainable five year cures.

The five year post-treatment period as an arbitrary standard for the evaluation of therapeutic measures is inadequate for mammary carcinoma, and may well be replaced by a minimum nine year period.—*Mary Frances Vastine.*

BRILL, I. C., and KRYGIER, JOHN J. Primary pulmonary vascular sclerosis. *Arch. Int. Med.*, Sept., 1941, *68*, 560–577.

Two requirements are suggested for a diagnosis of primary pulmonary vascular sclerosis: (1) evidence of right ventricular hypertrophy (without any evidence of hypertrophy of the left ventricle); (2) absence of any factor commonly recognized as productive of secondary pulmonary vascular sclerosis, pulmonary hypertension or isolated strain of the right heart. The author speaks of only about 20 cases fulfilling these requirements and described in the literature. He reports 1 of these cases.

The patient was a married woman, aged twenty-one, who had been a "blue baby" and who had been considered to have "heart trouble," on several occasions. With slight exertion, she suffered dyspnea, cyanosis, precordial pain, dizziness and fainting spells. Roentgenography revealed a prominence in the region of the pulmonary artery and conus and, for that reason, a congenital heart disorder was seriously considered but there were no murmurs. Her blood pressure was 85/70; basal metabolic rate, minus 14 per cent; red blood cell count, 5,700,000 with a hemoglobin of 122 per cent and a leukocyte count of 17,550. The electrocardiogram revealed a right ventricular preponderance. The patient experienced progressive dyspnea, palpitation, precordial pain, headache, dizziness, vertigo, fainting spells and now and then vomiting. Finally, edema of the ankles developed. Shortly thereafter the patient died suddenly.

The liver and spleen were slightly enlarged and there was about 200 cc. of serosanguineous fluid in the abdomen; none in the pleural cavity. There was no lung parenchymal consolidation. Arteriosclerotic plaques were found in the pulmonary arteries. The weight of the heart was 690 grams, its left chambers being distinctly small in contrast to dilated and hypertrophied

musculature of the right ventricle and right auricle. The wall thickness of the right ventricle was 7.5 mm., while that of the left ventricle was 7 mm. The circumference of the pulmonary valve was 8.5 cm., while that of the aortic valve was 6 cm. The foramen ovale was anatomically patent but functionally closed and no congenital cardiac defects were found. The coronary vessels were free of sclerosis. Microscopically, the most striking changes included intimal proliferation of the arterioles with complete occlusion of the lumina of many of them; numerous thrombi in the arterioles—some showing recanalization, and arteriosclerotic plaques in the walls of the larger ones.

In analyzing the 20 reported cases of this condition (abstracts of the other 19 being included), the following considerations are cited: Ages varied from ten to seventy-four, 14 being under the age of forty; the most important evidence was roentgenographic—prominence of the pulmonary artery and conus, along with electrocardiographic demonstration of right axis deviation; dyspnea, orthopnea, cyanosis, fainting spells, pain in the chest, vomiting, dizziness, hemoptysis, cough, being the predominant symptoms. Most showed a low systolic pressure with a contrastingly high diastolic pressure and an elevated venous pressure. Death occurred suddenly in 5 of the 20 cases. In only 2 cases was the diagnosis made prior to death.—*A. A. de Lorimier.*

Israel, Harold L., and Hetherington, H. W. Accuracy of fluoroscopy in the detection of pulmonary tuberculosis. *Am. J. M. Sc.*, Feb., 1941, *201*, 224–232.

Since 1933, fluoroscopic examinations of the chest have been routine for the study of new admissions at the Henry Phipps Institute. Likewise, periodic examinations and screenings have thus been accomplished.

This analysis concerns 1,021 duplicate examinations including fluoroscopy and roentgenographic studies. These examinations were accomplished by three groups of physicians: one group having extensive experience in fluoroscopy and roentgenologic interpretations; one group having considerable experience in fluoroscopy but little or no training in roentgenologic interpretation, and the third group having had no more than short periods of training in either. Abnormalities were classified as: "definite," "probable," or "possible."

In only 4 out of 48 cases having easily recognizable pathologic conditions were errors made. Satisfactory results were obtained even among obese patients. Though many minimal infiltrates were missed by the inexperienced, most of these were recognized fluoroscopically by those who were well experienced. Fluoroscopy was found to be especially trustworthy in the examination of children.—*A. A. de Lorimier.*

Farinas, Pedro L. Mucosography of the respiratory tract. *Radiology*, July, 1942, *39*, 84–87.

The internal surface of the organs of the respiratory tract can be studied by coating the mucosa with a very thin layer of contrast substance. The opaque medium is vaporized at the vestibule of the larynx and inhaled in fine particles. Films taken immediately after the inhalation show the mucosa as a thin dense line which contrasts sharply with the air in the organs.

The pharynx and larynx are anesthetized with 2 cc. of a 2 per cent solution of pantocaine and the trachea with 1 cc. of a 1 per cent solution of the same anesthetic. The contrast medium—Merck's 40 per cent solution of iodipin—is vaporized with an atomizer, the curved end of which is introduced behind the epiglottis. For examination of the larynx and upper part of the trachea only 5 cc. of iodipin is required. If the lower part of the trachea and the bronchi are to be examined 15 cc. is necessary. If there are any tumors of these organs they are outlined by the contrast medium and can be seen very clearly. Illustrative roentgenograms of the trachea, larynx and bronchi are given. The method is harmless, well tolerated, does not cause any injury of the glottis and its use is simple and easy.—*Audrey G. Morgan.*

LaDue, John S. Bronchiolitis fibrosa obliterans. *Arch. Int. Med.*, Oct., 1941, *68*, 663–673.

Bronchiolitis fibrosa obliterans appears to be a rare condition caused by local injury in the walls of the bronchi. Summarizing etiological descriptions of cases reported in the literature, there would seem to be three categories: Those cases caused by inhalation of irritants such as nitric or sulphuric acid fumes, poisonous gases and the vapors of certain solvents—or such as produced because of inhalation of foreign

bodies; pathological complications by certain acute infectious diseases such as measles, influenza, scarlet fever or even chronic bronchitis as found with asthma; those cases wherein no definite etiological factors can be recognized—the so-called idiopathic group.

Microscopically, the condition is characterized by numerous miliary, possibly multangular densities with fine white streaks radiating therefrom. These nodulations may be found to represent partly destroyed bronchioles with an overgrowth of granulation tissue. Frequently, the lumina are filled with detritis consisting of desquamated epithelium, polymorphonuclear leukocytes, fibrin and blood. Later, more and more fibrous tissue replacement occurs, possibly with bronchiectatic cavitations. There may be considerable emphysema, usually of the disseminated interstitial type. These changes may produce very severe respiratory distress: dyspnea, even cyanosis; possibly fever and cough with expectoration of mucoid or even bloody sputum.

The author reports such a case—the only one discovered among 42,038 autopsies performed by members of the Department of Pathology of the University of Minnesota Medical School since 1899. The patient was a twenty year old Negro, who was brought into the hospital because of unconsciousness, dyspnea and cyanosis. He later regained consciousness and described progressive weakness, fatigue and headaches, with chronic cough and hemoptysis, all developing over a period of several months. He had a temperature of 101.2°F. His respiration rate was 42 per minute. His red cell count was only 1,990,000; hemoglobin, 38 per cent. His white cell count varied from 8,000 to 16,000 with a polymorphonuclear differential as high as 79 per cent. He was placed in an oxygen tent but died nine days later.

Clinically, his case had been considered to be one of miliary tuberculosis. Little attention had been given to the patient's occupation—and his own remarks that his trouble was due to breathing a dye (trichlorethylene). *A. A. de Lorimier.*

CHAPMAN, JOHN, and WIGGINS, JOHN A. Circumscribed and isolated bronchiectasis. *Ann. Int. Med.*, May, 1941, *14*, 2047–2057.

Bronchiectasis is generally considered to be a widespread and diffuse disease involving a greater part of a lobe or several lobes.

Among more than 400 bronchographic studies at the State Tuberculosis Sanatorium, the authors have distinguished 6 as showing bronchial dilatations limited to one or a few bronchi. Reports of only 2 such cases were found in the literature.

All of these cases were featured by relatively mild symptoms but these, persistent, with expectoration and some purulent exudate but little or no hemoptysis. In all the cases, the dilatations were saccular in type and on the right side.—*A. A. de Lorimier.*

PAGEL, WALTER, and SIMMONDS, F. A. H. Cavity healing and bronchial occlusion. *Am. J. M. Sc.*, Feb., 1942, *203*, 177–187.

There are three methods of healing of cavities in tuberculous lungs: (1) by conversion into a solid caseous focus which may eventually calcify; (2) by formation of a radiating scar obliterating the cavity, and (3) by healing, leaving an open cavity. The first two methods are alike in the final result—closure of the cavity—but they differ in pathogenesis, and one is not the terminal stage of the other; that is, solid caseous material that tends to calcification is not likely to disappear and leave a fibrotic scar.

Work done by the authors in the Pathology Department of the Central Middlesex County Hospital, London, shows that the first is by far the most common method of healing. They describe 6 cases of their own in all of which healing took place by conversion of the cavity into a solid caseous nodule. A comparison of roentgen findings before death and necropsy findings shows that four to five weeks is the minimum time required for the process. A study of these 6 cases and 5 more of their own and 33 cases from the literature confirms their theory that this is the most frequent form of healing and that calcified nodules frequently mark the terminal stage of healing of former cavities.

There is anatomical evidence that occlusion of the draining bronchi, either by obstructive caseous bronchitis or the formation of a caseous plug is an important factor in causing this form of healing.

Roentgenograms and photographs of anatomical specimens illustrating the cases are given.—*Audrey G. Morgan.*

HAUSER, HARRY. Cancer of the lung in infancy. *Radiology*, July, 1942, *39*, 33–38.

Primary cancer of the lung in infancy is extremely rare. Only 3 cases have been reported

in the American literature. The case described in this report is the only one found in an infant in more than 14,000 autopsies performed at the Cleveland City Hospital in the past twenty-eight years.

The case was in a colored infant seventeen months of age who had developed dry cough five months before. She was admitted to the hospital on account of cough and dyspnea. Roentgen examination showed homogeneous increased density of the whole left half of the lung. The heart and trachea were considerably displaced to the right. She had suppurative otitis media and acute pharyngitis, and the lung condition was diagnosed as left empyema. But on aspiration of the left pleural cavity only a small amount of fluid was obtained with some fragments of tissue which suggested malignant tumor. The child grew worse progressively and died less than a month after admission. Microscopic examination showed that the tumor was a small cell carcinoma of the left lung. Roentgenograms and photomicrographs of the findings are given.

These tumors are rare even in childhood and early adulthood. The most common error in differential diagnosis is that of massive pleural effusion. If there are large dense homogeneous shadows on one side of the chest the possibility of primary bronchogenic carcinoma should always be considered. These tumors in infants are probably congenital rather than acquired. Avitaminosis A and influenza may be factors in causing metaplasia of the bronchial epithelium with later development of cancer. If the tumor is small and near the periphery it should be removed surgically. High voltage roentgen treatment may be useful for palliation when the disease is farther advanced.—*Audrey G. Morgan.*

Blackford, Staige D., and Casey, Carlton J. Pleuropulmonary tularemia. *Arch. Int. Med.*, Jan., 1941, *67*, 43–71.

In the thorax, as elsewhere, tularemia has been found to be primarily a necrotizing process, with foci of necrosis as the outstanding lesion. Lillie and Francis have described pulmonary lesions as basically nodular or confluent nodular in character, sometimes lobar in extent and involving one or all lobes. The pleurae may show fibrinous, fibrinocellular or fibrinocaseous exudation. These changes involve two processes: necrotization and a cellular reaction of the reticulo-endothelial-monocytic-epithelioid type.

These changes may simulate focal pneumonic lesions such as found in tuberculosis. Exudation into the pleural space may occur. Peribronchial infiltration may develop. More rarely, there may be a pneumothorax. Intrabronchial exudates may be responsible for atelectasis.

In 1935, thirty-five cases were reported from the University of Virginia Hospital. The present report pertains to 60 additional cases. Males outnumbered females approximately two to one as did also the ratio of whites to blacks. Seventeen of the group were less than twelve years of age. More than half were either farmers or housewives. Sixty-three of the 95 cases were ulceroglandular; 21, typhoid type; 7, glandular and 4, oculoglandular. Most of the infections were accounted for by rabbits but a few apparently resulted from contacts with ticks, squirrels, opossums, weasels or cats. The incubation periods varied from a few hours to two weeks; these were followed by ulcers or enlarged lymph nodes. It was because of the latter that most of the agglutination tests were performed but, in some instances, there was merely the suggestive history of contact, an unexplained fever or a chest condition of unknown cause. Diagnoses were confirmed by positive agglutination in all but one instance (in which case, it was confirmed by postmortem isolation of *B. tularensis*). The mortality rate for the series was 10.5 per cent.

The incidence of pneumonia in these infections has been variously reported as from 12.7 to 18.2 per cent. The onset of this pneumonia was usually more abrupt than that of a pneumococcic pneumonia. Physical signs were usually present within three weeks of the onset of the infection. Associated symptoms included cough, pain in the chest and dyspnea. The pulse and leukocyte count were usually low. Temperatures reached 104°F. or even higher. The duration of the illness was variable, pulmonary consolidations disappearing within ten days or persisting as long as six weeks. The mortality rate, with pneumonic involvement, is probably about 30 per cent.

Pleural fluid was obtained from 13 of the 95 patients, an incidence of 13.7 per cent. These effusions appeared to occur somewhat later after tularemic infection than in pneumonic processes. High fever was noted only in those patients who had associated pneumonia. The leukocyte count was usually normal or only slightly elevated. The amount of fluid varied from 100 to 3,650 cc.; its color usually being

yellow with little or no cloudiness. Positive agglutinations were found with this fluid as well as with blood serum. In 3 instances, inoculations of guinea pigs produced death from tularemia. Pneumothorax was rare.

Bronchitis was a common observation, it being noticeable in 19 of the 95 cases, some of which showed peribronchial roentgen evidence. Peribronchial prominence may persist for years. —*A. A. de Lorimier.*

SCHATTENBERG, H. J., and RYAN, JOHN F. Lymphangitic carcinomatosis of the lungs. *Ann. Int. Med.*, March, 1941, *14*, 1710–1721.

Lymphangitic infiltration of the pleura, peribronchial and perivascular lymphatics is not uncommon. It is frequently a secondary manifestation of carcinoma of the stomach (scirrhous type); other primary sites include: bronchus, breast, rectum, kidney, ovary, tongue, prostate and liver.

Gastric cancer is often clinically latent, having presented complaints of respiratory or circulatory embarrassment. Occasionally, with bone marrow involvement, the clinical picture may be predominantly that of a blood dyscrasia. With Krukenberg tumors, the primary clinical manifestations may be referable to the pelvis.

The case of a colored male, aged thirty-seven, is presented. The findings in the chest suggested a tuberculous bronchial pneumonia. Necropsy revealed a large infiltrated gastric tumor with extension through the pleura of the left lower lobe. The lymphatics were markedly dilated, containing neoplastic cells.

The author emphasizes the fact that this type of neoplastic extension is usually found in individuals under forty. The respiratory symptoms include progressive dyspnea—possibly cyanosis; possibly slight cough. The roentgen appearance is of a "strained design"—prominent branchings arising from the hila and developing into a finer network toward the periphery. The hilar lymph nodes may be prominent. There may be evidence of cor pulmonale. This condition must be differentiated from Ayerza's syndrome, pulmonary tuberculosis, pulmonary mycosis and blood dyscrasias.—*A. A. de Lorimier.*

SNIVELY, DANIEL, SHUMAN, HARRY, and SNIVELY, WILLIAM D. Spontaneous hemopneumothorax. *Ann. Int. Med.*, 1942, *16*, 349–356.

Spontaneous hemopneumothorax as distinguished from hemopneumothorax caused by trauma or following artificial pneumothorax is considered. In 1937 only 46 cases could be found in the literature since 1900.

The authors describe a case in a schoolboy suddenly taken with intense pain in the right side of the chest. He was a pale, asthenic youth whose health had been good, but he did have a history of having felt pain in the right chest on wrestling two months previously.

Fluoroscopic examination showed complete density of the lower two-thirds of the right lung. Thoracentesis on the right side posteriorly gave pure non-clotting blood, 450 cc. of which was removed by aspiration. There was air above the effusion. The patient was relieved of dyspnea but still felt very weak. The hemoglobin content of the aspirated blood was 65 per cent, the same as that of blood taken from the finger.

Ten days later 1,050 cc. more of non-clotting blood was removed. After that the chest roentgenogram gradually cleared up concomitantly with a decrease in the rate of sedimentation of the erythrocytes. After a little over four months the chest was completely clear, the excursions of the diaphragm normal and the patient was free of symptoms. Roentgenograms of the chest at different stages of the process are shown.

In such cases it is important to determine whether the hemorrhage is progressing. This can be accomplished by frequent blood counts on capillary blood, blood pressure examinations and serial chest roentgenograms or fluoroscopic examinations.—*Audrey G. Morgan.*

DOUB, HOWARD P., and JONES, HORACE C. Endothelioma of the pleura; clinical and roentgenologic study of three cases. *Radiology*, July, 1942, *39*, 27–32.

Three cases of endothelioma of the pleura are described and illustrated with roentgenograms. They were in women of fifty-two, thirty-three and eighteen years of age.

There has been a great deal of discussion as to whether these are true new-growths or products of inflammation. The authors are inclined to think that they originate from the endothelial cells of the lymph spaces or the lining cells of the pleura, as in most cases autopsy does not show any tumor of the lung parenchyma. They generally date from a cold or acute infection. There is generally fluid in the

pleural cavity and sometimes palpable lymph nodes, though this is not common. In the early stages the roentgenogram shows diffuse clouding with or without fluid. Later fluid appears and rapidly reaccumulates if it is removed. The flat tumor nodules on the surface of the pleura cannot be seen on roentgen examination unless the fluid is withdrawn and air introduced to produce an artificial pneumothorax. This is a valuable method of diagnosis in these cases. Diagnosis was made by this method in 2 of the cases here described and in all of them the diagnosis was verified by postmortem examination.—*Audrey G. Morgan.*

Penner, Abraham, and Druckerman, Leonard J. Segmental spasms of the esophagus and their relation to parkinsonism. *Am. J. Digest. Dis.*, Sept., 1942, *9*, 282–287.

Penner and Druckerman report 2 cases of spastic pseudodiverticulosis of the esophagus (functional esophageal diverticula of the esophagus).

One patient entered the hospital because of symptoms of complete esophageal obstruction, so severe that a gastrostomy had to be performed for alimentation. This patient was watched for twenty-two months and continued to exhibit roentgenologically typical spastic segmentation of the esophagus. Both cases occurred in aged individuals who exhibited evidences of parkinsonism. Administration of belladonna alkaloids caused in both cases complete disappearance of the spasms, and marked amelioration in the case which presented esophageal symptoms.

The clinical association of parkinsonism with the syndrome of spastic pseudodiverticulosis of the esophagus in which changes observed roentgenographically are located in that portion of the esophagus containing striated muscle, correlated with the subjective and objective improvement obtained with belladonna alkaloids, and the recurrence seen on stoppage of the treatment, lends support to the suggestion that the so-called spastic pseudodiverticulosis of the esophagus is one of the manifestations of parkinsonism.—*Franz J. Lust.*

Kaplan, S. Bernard, and Zwaifler, Nathan. Peptic ulcer of the esophagus. *Rev. Gastroenterol.*, March–April, 1942, *9*, 108–112.

Peptic ulcer of the esophagus usually occurs in the lower third of the esophagus, near the cardia, usually single, round or oval in outline when small, and may be irregular in outline and as large as 10 cm. in diameter. If the ulcer is of recent origin and superficial, the edges are clear cut and well defined and the base is red and granular. If the ulcer is of long duration, it presents a typical punched-out appearance with a funnel-shaped base similar to gastric ulcer. The ulcer may heal spontaneously with varying degrees of cicatricial contraction or stenosis, or may rupture into the peri-esophageal connective tissue, pericardium, or the right or left pleural cavity.

The symptomatology of esophageal ulcers is pain occurring directly after the act of swallowing, or even during the act of swallowing. This pain is usually a constant symptom and occurs in the epigastrium beneath the sternum and may radiate toward the back between the shoulder blades. Dysphagia is a prominent symptom; it is at first observed only on taking solid food, but later there is difficulty in taking even liquids. At the beginning there is a spasm which disappears rapidly. As the spasm increases, regurgitation follows and finally, in the stage of cicatricial stenosis, the obstruction is continuous. Vomiting is first due to spasm and later to stricture. Nutrition is undermined, the patient loses weight; hemorrhages may occur in about 40 per cent of the cases of esophageal ulcer. When hemorrhage occurs it is without nausea or effort.

The authors report the case of a boy, aged nine, who had had difficulty in swallowing and frequent periods of vomiting since birth. During the past year he would frequently awake with pain in the upper epigastrium which was relieved by sipping a little bicarbonate of soda solution. It was almost impossible for him to swallow solid food. The roentgen examination of the esophagus showed a concentric constriction at about the level of the eighth thoracic vertebra. Above this point the esophagus was partly dilated; however, the esophagus showed a certain elasticity. The direct examination revealed a small circumscribed easily bleeding ulcer. The pathological examination of a biopsy showed a gastric mucosa with erosion.—*Franz J. Lust.*

Doane, Joseph C., and Pressman, Robert. Antemortem diagnosis of tumors of the heart. *Am. J. M. Sc.*, 1942, *203*, 520–524.

Metastases of malignant tumors to the heart are not extremely rare, but until recently most

of them were diagnosed on autopsy. But in recent years 19 cases have been diagnosed before death and the authors present a 20th. A table showing the prominent features of these cases is given.

In one group of patients with heart metastases the symptoms are not suggestive. The patient may have a sudden congestive heart failure, show the picture of subacute bacterial endocarditis or may die suddenly and unexpectedly. In another group the symptoms are more definite. There are various abnormalities in the rhythm of the heart, such as auricular fibrillation, heart block, extrasystoles or paroxysmal tachycardia. One of the most significant findings is fixation of the right border of the heart shown on fluoroscopy.

Whenever a patient with a history of cancer, particularly of the adrenals, bronchi, lungs, or bones shows any of the above symptoms or an Adams-Stokes syndrome, malignant metastasis in the heart should be suspected if there is no evidence of rheumatic or arteriosclerotic heart disease, toxic conditions or a history of an old cardiac infarct.

The case described was in a woman of thirty-two in whom a diagnosis of adenocarcinoma of the cervix was made in October, 1937. Beginning November 9, 1938, a series of roentgen treatments amounting to 875 r was given.

On April 12, 1941, she was admitted to hospital complaining of cough and breathlessness, swelling and cyanosis of the face and neck and greatly dilated veins over most of the front of the thorax. The right arm was greatly swollen, the left only slightly edematous. An electrocardiogram made April 16 showed sino-auricular block. On April 19, 1,200 and 1,300 cc. turbid fluid was removed from the right and left pleura.

A diagnosis of malignant metastasis involving the superior vena cava, the right heart, the pleura and the cervical lymph nodes was made on the basis of the obstruction to the return flow of blood from the head and upper chest, the sinoauricular block and the signs of metastases to the pleura.

The patient died April 22, and autopsy showed metastases to the skin of the neck and upper chest, the superior vena cava, the pericardium and the roof of the right auricle.—*Audrey G. Morgan.*

## ABDOMEN

Abels, J. C., Rekers, P. E., Binkley, G. E., Pack, G. T. and Rhoads, C. P. Metabolic studies in patients with cancer of the gastrointestinal tract. II. Hepatic dysfunction. *Ann. Int. Med.*, Feb., 1942, *16*, 221–240.

The authors have shown in previous work that patients with cancer of the gastrointestinal tract have an abnormally low vitamin A content in the plasma. This was believed to be due to the fact that the livers of these patients were unable to store or distribute the vitamin properly.

They therefore carried out further tests of liver function, the technical details of which are described. It must be remembered that liver function tests are at best crude and that the liver may be seriously damaged before it shows insufficiency in response to tests.

They tested normal individuals, patients with atrophic gastritis and leukoplakia of the mucous membrane of the mouth, patients with cancer of the gastrointestinal tract and patients from whom such cancers had been removed successfully by surgery. Tables and graphs are given showing the details of the results.

These prove that patients with cancer of the gastrointestinal tract have a much higher incidence of liver insufficiency than any of the other groups examined. This dysfunction of the liver in patients with cancer of the gastrointestinal tract is especially dangerous as they are often subjected to prolonged anesthesia and serious surgical operations which would damage even a normal liver. This makes postoperative care of these patients a serious problem. The insufficiency of the liver may cause delayed healing of the wound, stubborn anemia, hemolytic reactions to transfusion, hypoproteinemia and hypoprothrombinemia.—*Audrey G. Morgan.*

Levy, Jerome S., and Smith, Randolph T. Trichobezoar. *Am. J. Digest. Dis.*, June, 1942, *9*, 198–200.

Since the first case of trichobezoar was recorded in 1779, the authors have found 173 cases of this type reported in the literature. They report their findings in a patient whose chief complaints were pains in the stomach and a mass in the stomach for the last two years. She appeared to be mentally deficient. The patient admitted swallowing hair and snuff during her three pregnancies, but not at any other time.

On examination a mass was seen in the upper part of the abdomen extending from under the left costal margin downward toward the umbilicus and across, fading out towards the right upper quadrant. This mass seemed to be smooth, rounded, and moved on respiration. It was in the position of the stomach. On palpation it felt hard, smooth, not tender, and was of the shape of the stomach.

The roentgen examination showed, on a flat plate, a shadow of increased density in the region of and in the shape of the stomach. This was demonstrated by the barium meal as an intragastric mass freely movable within the stomach, and extending into the duodenum and probably, also, into the jejunum.

At operation, a dark green-black mass of hair was removed from the stomach. It formed a perfect cast of the stomach and was covered with the usual slimy, foul, greenish-yellow fluid. The anterior surface of the fundus of the stomach about at the level of the rib margin was adherent to the anterior abdominal wall.

When the stomach had been emptied of its hair ball, a definite ulcer of the anterior wall of the stomach which had perforated and adhered to the abdominal wall was found. There was not any infiltration or exudation in the gastric wall or in the peritoneum. This was probably the cause of the severe pain experienced at the beginning of her last pregnancy. After the hair ball had been removed and the ulcer found and examined, it was decided to incise the duodenum and remove the remainder of the hair ball which could be felt to extend into the jejunum for an inch or two. As traction produced some movement more traction was employed and the entire mass was brought back through the gastrostomy opening.

The roentgenograms and photographs of the specimen demonstrate clearly the first mass in the stomach, and the second mass which filled the duodenum and upper jejunum.

Trichobezoar of the duodenum and jejunum is extremely rare.—*Franz J. Lust.*

Gray, Howard K. The diagnosis and treatment of cancer of the stomach. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 487–490.

This study is based on all the cases of malignant lesions of the stomach observed in the years 1907 to 1938 inclusive (at the Mayo Clinic). The seriousness of cancer of the stomach is emphasized when it is noted that, with the possible exception of primary cancer of the lung, the five year survival rate after the diagnosis of cancer of the stomach has been made is appreciably lower than the five year survival rate in cases in which a diagnosis of cancer of the fundus of the uterus, thyroid gland, breast, uterine cervix, or large intestine has been made.

*Symptomatology.* (1) In 60 per cent of the cases, the "unusual" type of symptomatologic picture of a malignant lesion of the stomach was noted in which dyspepsia was the most prominent symptom and was associated with varying degrees of decline. (2) Thirty per cent of the patients portrayed the picture of "ulcer" which was characterized by epigastric pain occurring characteristically when the stomach was empty and which was relieved by the ingestion of food or alkali. (3) 793 patients had received some type of therapy for ulcers and 81 per cent of these patients had experienced definite subjective improvement. This observation would seem to discredit the value or the advisability of the use of the response to treatment as a criterion for distinguishing a malignant lesion from a benign ulcer. (4) The fact that a patient has had symptoms referable to the stomach for a long time is no criterion upon which to exclude the presence of a malignant lesion of the stomach.

*Roentgenologic Diagnosis.* (1) At the Mayo Clinic, approximately 9 per cent of carcinomatous ulcers had been diagnosed as benign by a roentgenologist. (2) In 18 per cent of all cases of cancer of the stomach in which roentgenologic diagnosis was made, it was not possible to determine the exact nature of the lesion. (3) It is significant that some type of abnormal lesion of the stomach was noted in 99 per cent of cases in which a malignant lesion of the stomach was present.

The author and his associates are in agreement with Allen and Welch who studied 277 cases in which a surgical diagnosis of gastric ulcer was made. In 14 per cent of these cases, the lesion finally proved to be malignant. Operation is recommended if (1) the gastric ulcer is of short duration and the patient is more than fifty years old; (2) the ulcer is more than 2.5 cm. in diameter; (3) there is no free hydrochloric acid in the gastric contents; (4) the ulcer is situated on the greater curvature or in the prepyloric region; (5) the ulcer is chronic and is on the lesser curvature.

*Treatment.* In most instances, the question of operability, from the roentgenologic standpoint, depends on the situation, the extent, and

the character of the cancer. Carman divided the stomach into three zones: the operable zone, corresponding to the pars pylorica; the borderline zone, corresponding to the pars media; and the inoperable zone, corresponding to the pars cardiaca. Roentgenologic evidence alone, however, should not be sufficient evidence in occasional cases to deny the patient what benefit may be derived from surgical exploration. This is particularly true of lesions situated primarily in the fundic portion of the stomach or near the cardiac orifice as great progress has been made in the transpleural approach to these lesions.—*Mary Frances Vastine.*

GARLOCK, JOHN H. Radical surgical treatment for carcinoma of the cardiac end of the stomach. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 555–560.

During the past four years, the writer has explored 25 patients with adenocarcinoma of the cardiac end of the stomach. Nine of these were found to be operable.

Carcinoma of the cardiac end of the stomach is discussed from the standpoint of:

(1) *Anatomy and Histology.* It is important to remember that carcinomas originating in the cardia assume the histopathological features of an adenocarcinoma in contradistinction to the squamous cell tumors arising in the esophagus.

(2) *Lymph Node Spread.* In general, it may be said that adenocarcinomas arising at the cardia spread peripherally below the diaphragm toward the gastrohepatic or gastrocolic lymph nodes. Extension above the diaphragm to the nodes in the posterior mediastinum occurs not infrequently. Early metastatic involvement of the liver is a frequent finding.

(3) *Symptoms.* Cancers arising at the cardiac orifice quickly interfere with the act of deglutition and produce symptoms of lower substernal pain, especially on swallowing. However, it is important to emphasize that many of these patients may have persistent indigestion which resists medical treatment or that there may be an unexplained loss of weight. However, an analysis of these cases indicates that loss of weight does not reach the extremes frequently seen in operable squamous cell carcinomas of the esophagus.

(4) *Roentgenographic Findings.* The most common findings are obstruction of the lower esophagus, irregular filling defects at the cardia, rigidity of the lesser curvature on fluoroscopic observation, and loss of the normal mucosal pattern. It may be difficult to demonstrate any abnormality when the tumor is located on the posterior wall toward the incisura.

(5) *Treatment.* Every patient presenting the symptom of dysphagia, associated with positive findings in the roentgenograms should be subjected to esophagoscopic examination. A biopsy will indicate whether the tumor has arisen from the esophagus or the stomach. There seems to be general agreement that the operation of choice for cancer of the lower esophagus and cardiac end of the stomach is a left transthoracic, transdiaphragmatic resection with intrathoracic esophagogastrostomy.

(6) *Results.* The patient with a resectable cancer of the upper end of the stomach has a 60 per cent chance of surviving the operation and an 80 per cent probability of living more than two years.—*Mary Frances Vastine.*

PALMER, WALTER L. Peptic ulcer and gastric secretion. *Arch. Surg.*, March, 1942, *44*, 452–472.

The presence of acid gastric juice is necessary for the production of peptic ulcer. Chronic peptic ulcer has only been produced experimentally by methods which prevent the neutralization, dilution or buffering of the gastric content as it passes from the stomach. The chief protection against acid attack on the gastric mucosa seems to be the thin layer of mucus with which it is covered. If this is wiped away or dissolved ulcer develops.

Chronic peptic ulcer occurs only in persons whose gastric mucosa is capable of secreting acid gastric juice. Reports of cases occurring in persons with achlorhydria are based on mistaken evidence. No cases of peptic ulcer have been found in hundreds of cases of pernicious anemia examined.

Gastric ulcer may occur in stomachs with a low secretory response to histamine, probably as a result of poor protection of the mucosal cells. The pain in peptic ulcer is also probably caused by the action of the acid on nerve endings, the pain threshold of which is lowered by inflammation.

Such ulcers could be healed by producing complete and permanent achlorhydria. Sippy developed a method of treatment based on the use of food and alkali. Rest and milk diet is one of the oldest treatments. Various extract that depress gastric secretion, notably extracts

of the posterior pituitary, have been used. Intensive irradiation brings about depression of gastric secretion lasting a variable time. Among 88 patients treated by Palmer and Templeton complete histamine achlorhydria developed in 35 and persisted for periods of from a few days to a few months. During the periods of achlorhydria the ulcers healed.

The indications for surgical operation are due to complications. The most frequent indication is stenosis, the most urgent acute perforation. Massive hemorrhage is best treated medically at the time of the hemorrhage, though surgical attempts may be made to tie off the bleeding artery or excise the tumor. In cases of recurrent hemorrhage subtotal resection has been performed, but even this does not ensure that the hemorrhage will not recur. No medical or surgical method except total gastrectomy results in complete and permanent achlorhydria, and therefore there is no other method of permanently curing peptic ulcer.—*Audrey G. Morgan.*

Walters, Waltman. Gastric ulcer, benign or malignant. *Arch. Surg.*, March, 1942, *44*, 520–530.

The author believes that all ulcers of the stomach should be removed surgically on account of the impossibility of making a definite differentiation between benign and malignant lesions. Mistaken differentiations have been made in about 10 per cent of the cases at the Mayo Clinic on roentgen examination, and even gastroscopic examination is not free of error. Moreover, malignant lesions sometimes respond for a time to medical treatment as do benign ones. Also in some cases of gastric ulcer, benign or malignant, the ulcer so interferes with the neuromuscular activity of the stomach that a marked degree of pylorospasm is brought about, which gives the mistaken impression that the lesion is in the duodenum and benign, while in reality it is on the lesser curvature and may be malignant.

Surgical treatment has given excellent results in ulcer. With progress in surgery the danger has decreased. The mortality is now not more than 5 per cent and 89 cases were operated on at the Mayo Clinic in 1939 with a mortality of only 2.2 per cent.

The author thinks the method of choice is subtotal gastrectomy extending well beyond the lesion. In occasional cases with ulcers high on the lesser curvature or the posterior wall excision of the ulcer with gastroenterostomy has given excellent results.—*Audrey G. Morgan.*

Dowdle, Edward. Multiple, primary nonspecific jejunal ulcers, with chronic duodenal dilatation. *Ann. Surg.*, Sept., 1942, *116*, 348–354.

Dowdle reports a case of jejunal ulcer. The patient was fifty-nine years of age, had had occasional spells of indigestion and dyspepsia for more than ten years. Occasionally he had passed black stools. His condition had grown worse, for during the last six months, previous to hospital admission, he had vomited one to two hours following meals and had lost over 40 pounds. The roentgen examination demonstrated an obstruction of the small bowel in the region of the ligament of Treitz. This had produced almost complete obstruction with marked dilatation of the entire duodenum and stomach. Autopsy revealed that there was a shallow ulcer and another annular ulcer in the duodenum. The base and border of the ulcer was thick and fibrous. The microscopic examination showed infiltration with lymphocytes; Meissner's plexus, as well as the ganglion fibers, was distinctly swollen. There was no evidence of a neoplastic condition

According to Dowdle, only very few cases of nonspecific ulcers have been reported in the literature. This article shows the roentgenograms and the macroscopic and microscopic findings in this case.—*Franz J. Lust.*

Sussman, Marcy L., and Wachtel, Emanuel. Granulomatous jejuno-ileitis. *Radiology*, July, 1942, *39*, 48–53.

This study is based on 23 cases of granulomatous jejuno-ileitis, which is an inflammatory disease of the small intestine. There is some question as to whether it is a primary infection or occurs secondarily in patients with deficiency disease. The average age of the patients was twenty-seven years, the extremes nine and sixty-five years. Diarrhea and abdominal pain were the outstanding symptoms. Fever, vomiting and loss of weight occurred in 25 per cent. The average duration of symptoms before admission was two years with a range of from three days to eight years. Right lower quadrant pain, vomiting and malnutrition were seen in about 40 per cent of the cases. Twenty-five per cent of the patients had perianal ab-

scess with or without fistula. There was clubbing of the fingers in 40 per cent of the cases. In 2 cases there was no glossitis; there were no other signs of avitaminosis. In only 2 cases was there a macrocytic hyperchromic anemia.

In the acute stage the mucosa is very much inflamed, edematous and thickened; in the subacute stage the mucosa is hypertrophied and granular with punched-out ulcers. In the chronic stage the wall of the affected segments of the intestine is thickened with marked submucosal fibrosis. There are normal areas between the diseased parts.

The roentgen findings follow the pathological findings closely. In the acute stage differentiation between inflammation and deficiency disease is difficult, but inflammation is indicated by an acute clinical course, involvement of the terminal ileum, the presence of segments of normal bowel separating the diseased areas, stenosis and serration suggesting ulcers. In the chronic stage there is rigidity and stenosis which sometimes causes obstruction. It is probable that many cases that have formerly been diagnosed as tuberculosis of the intestine are really cases of this disease.—*Audrey G. Morgan.*

MAYO, CHARLES W., and SCHLICKE, CARL P. Carcinoma of the colon and rectum; study of metastasis and recurrences. *Surg., Gynec. & Obst.*, Jan., 1942, *74*, 83–91.

A clinicopathological study of 334 cases of carcinoma of the colon and rectum is presented and the following conclusions are noted:

(1) Regional or distant metastasis occurred in 60.5 per cent of the cases and local invasion in 39.2 per cent. Among cases in which there was hepatic metastasis no correlation could be found between the site of the primary tumor and the site of involvement in the liver.

(2) The ability of the surgeon to detect metastasis at the time of operation was found to be good. Among cases in which death occurred shortly after resection, no metastasis was found at necropsy in 82.4 per cent of those in which none was found at operation.

(3) The success of extirpation was revealed in this same group of cases, 65 per cent of those in which there was metastasis at operation being free of it at necropsy. Residual cancer was found in only 5.3 per cent of the cases in which death occurred shortly after resection. In those cases in which the surgeon believed metastatic growth to be present in the liver, the pathologist confirmed the impression in 91.7 per cent.

(4) Independent growths are felt to be responsible for many "recurrences." Polyps were present in 34.1 per cent of the cases in this entire series, in contrast to 16.0 per cent of a control series consisting of patients without cancer of the bowel. In 14.0 per cent of the cases in which polyps occurred, malignant changes were found in the polyps. Multiple carcinomas were found in 8.4 per cent of the cases. Among cases in which resection was carried out, additional independent cancers were found at necropsy in 4.1 per cent.

(5) Whenever a carcinoma is found in any portion of the colon or rectum, the presence of a second carcinoma must be carefully ruled out. After operation, the malignant potentialities of the remaining mucous membrane should be borne in mind and careful follow-up studies carried out.—*Mary Frances Vastine.*

SAILER, SEATON, and MCGANN, R. J. Lipophagic granulomatosis of the enteric tract. *Am. J. Digest. Dis.*, Feb., 1942, *9*, 55–63.

Granulomatous lesions characterized by the presence of great numbers of large mononuclear cells having an abundant cytoplasm richly interspersed with coarse fat particles, droplets of fat lying free or partially phagocytosed by multinucleated foreign body giant cells, and varying admixtures of small lymphocytes, plasma, polymorphonuclear, and fibroblastic cells, have been classified histopathologically as lipogranulomas. These reactions are predominantly local in character and confined to adipose tissue.

The authors report a case of a middle aged man who suffered from abdominal pain, weakness, loss of weight, loss of appetite, and marked epigastric discomfort after eating. In addition, there was swelling of both ankles and feet. The stools were normal in color, consistency and form. There was no diarrhea or steatorrhea.

The physical findings which were outstanding were the edema of the ankles, a very low blood pressure. A gastric analysis showed complete absence of hydrochloric acid after histamine. The glucose tolerance curve was very flat. The anemia was of hypochromic type with regeneration such as is noted in chronic blood loss.

The roentgen examination showed the esophagus and stomach within normal limits. The duodenal cap was not deformed and visualized well. Some dilatation was present in the second portion of the duodenum due apparently to hypomobility. Further on in the jejunum hypo-

mobility was conspicuous and definite puddling of the barium was noted with occasional irregular areas of spasm. The valvulae conniventes were irregular, distorted and somewhat indistinct; in a few areas they appeared thickened and unduly separated. At six hours there was still a very small amount of barium within the stomach. The greater portion occupied the lower small intestine. The colon had lost its normal haustral markings. It contained scattered portions of barium and some were present in the rectum.

The pathological diagnosis was lipophagic granulomatosis of the small intestine with massive infiltration of the regional mesentric, peripancreatic, and periaortic lymph nodes; ascites; bilateral hydrothorax; diffuse organizing pericarditis; interstitial fibrosis of pancreas (slight), and chronic atrophic gastritis.

The pathological changes were characteristically confined to the inner coats of the jejunum and ileum with massive infiltration and enlargement of the draining mesenteric and adjacent peripancreatic lymph nodes. However, there appeared to be considerable variation in the degree of small bowel involvement. In several cases reviewed the lesions were minimal or lacked entirely the characteristic features common to the mesenteric nodes. Studies on the fate of lipophagic granulomas elsewhere in the body demonstrate that spontaneous resorption of the free or engulfed fat droplets is not uncommon and marked regressions in the cellular architecture occur. Such reversible changes might conceivably have taken place in the intestine without any appreciable change in the lymph node reaction. The sensitivity of the latter to roentgen therapy is of therapeutic interest. The means by which lipophagic granulomas are formed within the small intestine and regional lymph nodes is obscure.—*Franz J. Lust.*

Hubeny, Maximilian J., Marcus, Samuel M., and Ragins, Alex B., Calcification of the gallbladder; roentgenographic and pathologic study. *Radiology*, July, 1943, *39*, 88–91.

The pathogenesis of calcified gallbladder is not definitely known. In a large percentage of the cases, Robb says 90 per cent, there are also gallstones. It is probable that calcium carbonate stones or milky suspensions of calcium carbonate are brought about by obstruction of the cystic duct by stones, cancer or inflammation, the calcium carbonate being produced by the gallbladder wall.

On roentgen examination the gallbladder has a rigid and fixed appearance and peripheral calcification can be seen. Sometimes, however, it is hard to differentiate these calcium shadows from those of gallstones, renal and ureteral calculi, calcified mesenteric nodes, calcified echinococcus cyst, calcified fecaliths in an undescended appendix and in old people calcified deposits in the sternocostal cartilages.

Six cases are reported in which calcified gallbladder was suspected on roentgen examination. Operation was performed in 5 of the cases and in one operation was refused. The diagnosis of calcified gallbladder was verified in 3 of the cases.—*Audrey G. Morgan.*

Golob, Meyer, and Kantor, John L. Two cases of double gall bladder. *Am. J. Digest. Dis.*, April, 1942, *9*, 120–123.

The authors report 2 cases of double gallbladder. They review the literature and find that their cases are probably the seventh and eighth cases disclosed by cholecystography.

In both cases the dye test yielded normal sequence. The organs filled, concentrated, and emptied, in response to a fatty meal. The fundi of the gallbladder were free as demonstrated in the roentgenograms taken after a fatty meal. This suggests that they were not held together by serous covering.

The roentgenograms of the first case show the double organ especially well after the fatty meal. In the second case there was a slight time difference of appearance of the dye in the second gallbladder. After a fatty meal the concentration of the dye in both gallbladders was of the same intensity.

As the organs did not show any pathological condition, operative control was not possible.—*Franz J. Lust.*

Schindler, Rudolf, and Arndal, O. Gastroscopic differential diagnosis of benign and malignant ulcer of the stomach. *Arch. Surg.*, March, 1942, *44*, 473–488.

The authors believe that gastroscopic examination is the best method of differentiation between benign and malignant ulcers of the stomach. They discuss a series of 113 cases in which both gastroscopic and roentgen examinations were made. In this series 6 wrong gastroscopic diagnoses were made and in 2 cases no definite results were arrived at, while 7 wrong roentgen diagnoses were made and in 15 no definite differentiation could be made.

They give as gastroscopic signs in favor of benign ulcer: perfectly sharp edges without a surrounding wall, no infiltration of the mucosa whatever, hemorrhages and pigment spots lying in a normal mucosa, arch-shaped distortion of the angulus, hourglass fold and converging folds. Signs which are not proof of benign ulcer are: normal mucosa distant from the ulcer, uniform color of the wall and the surrounding mucosa and mucosal islands within the ulcer.

Signs which speak in favor of malignant ulcer are: limiting wall on one side and blending infiltration on the other, large tumor nodes and masses around the ulcer, irregular ridges or nodes in the ulcer floor, diffuse infiltration of the whole stomach, even without visualization of the ulcer, white, crystal-like floating material on the floor of the ulcer, location in the antrum close to the greater curvature, visible ulcer in the pylorus, bleeding of the edge, dark red color of the ulcer and pale surrounding tissue, the edge blending gradually with the surrounding mucosa, ulcerations on the wall surrounding the ulcer. Gastric signs which are not proof of malignant ulcer: large size, atrophic gastritis, infiltration of the mucosa about the ulcer, callous or edematous wall, ragged edge, bell-like elevated area, necrotic material in the floor of the ulcer, regular nodes on the floor.—*Audrey G. Morgan.*

CULVER, GORDON J., BECKER, CHARLES, and KOENIG, EDWARD C. Calcified cystic tumor of the spleen. *Radiology*, July, 1942, *39*, 62–68.

Non-parasitic cysts of the spleen are rare as compared with echinococcus cysts. Among 800 splenectomies performed at the Mayo Clinic from 1904 to 1934 only 4 cysts of the spleen were found, an incidence of 0.5 per cent.

A case of such a cyst is reported in a woman of twenty-five who came for examination for appendicitis. She had pain at the site of the appendix without associated gastrointestinal symptoms. But for about two years there had also been a good-sized mass in the left upper abdomen. Roentgen examination showed elevation of the left half of the diaphragm with a large well circumscribed area of density below it. The lower border of the shadow was rounded and calcified. There was also an area of mottled calcification inside the mass. The stomach was displaced downward and to the right and the splenic flexure was displaced downward. Except for the displacement the stomach was normal.

On operation the appendix was removed through the usual incision and then a left rectus incision was made which exposed the large cystic tumor of the spleen which on removal was found to measure 22×15×10 cm.

Tumors of the left upper quadrant may originate from the spleen, left kidney, splenic flexure, stomach, left lobe of the liver or tail of the pancreas. The best method of localizing them is by roentgen examination with barium contrast. The importance of roentgen examina- in lesions outside the gastrointestinal tract is emphasized. Roentgenograms and microphotographs of the histological findings are given.—*Audrey G. Morgan.*

## GYNECOLOGY AND OBSTETRICS

SPALDING, H. C. Chondrodystrophic dwarfism in pregnancy. *Am. J. Obst. & Gynec.*, April, 1942, *43*, 720–722.

Gruggisburg distinguished between proportionate and unproportionate dwarfism or nanosoma, chondrodystrophic dwarfs being in the latter group. Kaufman states that this condition may appear in either intrauterine life or some time after birth and that the deviation from normal is chiefly in the shortness of the long bones. The soft tissues are normally developed so that the redundant skin hangs in folds. These changes are due to incomplete growth of the cartilage and early cessation of enchondral ossification. When observed at birth, this condition has been erroneously called fetal rickets. Nothing is known of its etiology or therapy. A few patients have been reported living past thirty and one even to the age of eighty. The majority, however, die in the first few weeks of life. None is taller than 140 cm. Some may be of high intelligence.

Two cases of pregnancy in chondrodystrophic nanism are reported. Both patients were colored, one was 119 cm. tall and the other, 132 cm. The blood calcium in one of the dwarfs was 7.2 mg. per 100 cc. The child of one patient showed chondrodystrophy at the age of three.—*Mary Frances Vastine.*

STEIN, IRVING F. Gynecographic aid in the diagnosis of ectopic pregnancy. *Am. J. Obst. & Gynec.*, March, 1942, *43*, 400–409.

For the diagnosis of early and especially unruptured ectopic pregnancy and for tubal mole, two methods of roentgen examination are avail-

able which may be grouped under the term "gynecography": (1) hysterosalpingography which is dependent upon the use of an opaque substance; (2) pneumoroentgenography which employs a gaseous medium to produce pneumoperitoneum. These two methods can be used independently or combined with each other.

Transabdominal pneumoroentgenography may be used without danger of disturbing a pregnancy. The patient is roentgenographed in the partial knee-chest posture, the technique for which has been outlined in an earlier paper. Tubal pregnancy often appears as a dense, cone-shaped shadow, the apex arising from the uterine horn. Transabdominal pneumoperitoneum is more valuable, more informative and less harmful than hysterosalpingography. The two methods may be combined in selected cases with excellent results. For example, in cases of old quiescent tubal pathology where the diagnosis of an ectopic pregnancy must be considered, a combination of the two methods may prove of value in arriving at a diagnosis. Gynecography has a negative value in the diagnosis of ectopic pregnancy in that it may show definitely intrauterine pregnancy with normal adnexa, ovarian cyst, and/or other lesions to account for the patient's symptoms, and thus rule out the presence of ectopic pregnancy.—*Mary Frances Vastine.*

Haugen, John A., and Ehrenberg, C. J. Diaphragmatic hernia in the newborn infant. *Am. J. Obst. & Gynec.*, March, 1942, *43*, 502–507.

Before 1935, congenital diaphragmatic hernia in the newborn infant was considered to be extremely rare and unamenable to treatment. In reality, it is not a rare finding. In a series of 5,269 autopsies on stillbirths and infants up to one year of age from the Department of Pathology at the University of Minnesota, there were 38 diaphragmatic hernias, or one in 139 autopsies in this age group. This condition can be treated surgically with more than a 60 per cent recovery. Two case reports are given.

In the first case, nothing abnormal was noted until the fourth day of life when, after a breast feeding, the infant became extremely cyanotic. The cyanosis increased in severity and a roentgenogram revealed a left diaphragmatic hernia. A laparotomy done on the ninth day revealed that the entire small intestine and spleen were in the left chest cavity. Recovery was uneventful and the infant's development has continued normally.

Cyanosis and labored grunting respirations were noted at birth in the second case. Roentgen examination revealed the diagnosis, and six hours after birth the abdomen was opened and nearly the entire gastrointestinal tract and about half of the liver was found to be in the right chest cavity.—*Mary Frances Vastine.*

Ball, Robert P., and Golden, Ross. A roentgenologic sign for the detection of placenta previa. *Am. J. Obst. & Gynec.*, Sept., 1941, *42*, 530–533.

The roentgen sign reported is applicable only in cases with a single fetus in cephalic presentation (about 95 per cent of pregnancies) and is based on the fact that a fetal head will dip into the pelvic inlet and occupy the midcoronal and midsagittal planes of the superior strait when the mother is standing. Any pelvic tumor mass of sufficient size can displace the fetal head from the midcoronal or midsagittal plane or prevent it from dipping below the level of the brim of the inlet.

Roentgenograms of the pelvis are taken in anteroposterior and lateral views with the patient standing. Normally, in the last trimester of gestation, the fetal head will be found in the midsagittal and midcoronal planes of the superior strait, and, even if not engaged, it will be dipping below the level of the brim of the true pelvis. The authors have accepted, for a tentative working basis, a linear displacement of one-third the diameter of the fetal head from its usual position to represent the presence of an abnormal pelvic mass.—*Mary Frances Vastine.*

Buxton, Bertram H., Hunt, Russell R., and Potter, Charles. X-ray localization of the placenta. *Am. J. Obst. & Gynec.*, April, 1942, *43*, 610–619.

The clinical material studied consists of 126 cases of painless bleeding in the last trimester of pregnancy. At present, two separate procedures are used by the authors:

(1) The taking of right and left lateral films of the entire uterus with a technique described by Snow and Powell, which is designed to give maximum soft tissue contrast.

(2) Anteroposterior roentgenograms of the pelvis taken by a precision stereoscopic technique with 4 per cent sodium iodide in the bladder. In these films also, a modified soft tissue technique is employed.

The lateral films are taken with the patient recumbent, lying comfortably on the side. No special apparatus is necessary. By the soft tissue technique employed, the placenta has been localized in 86.1 per cent of the 108 cases where this procedure was employed. Of these, 74 were fundal on the anterior or posterior wall and 19 showed the placenta to lie wholly or in part in the lower uterine segment. In 9, no placenta was seen and in 4 there was uncertainty about the significance of the shadows.

The second method of examination is employed only in those cases where soft tissue roentgenograms fail to reveal the placenta, show it to lie partly in the lower uterine segment, or are equivocal. The purpose of these films is to demonstrate an increase in the thickness of the soft tissue space lying between the presenting part and the filled bladder. Normally this space is occupied by the bladder wall, the peritoneal reflections between the bladder and the uterus, the lower uterine segment, the membranes, and the fetal scalp. It measures from 1 to 2 cm. in thickness. In central placenta previa the interposition of the placental mass may increase the distance to 5 or 6 cm. With marginal or partial previas, there is unilateral widening either anteriorly, posteriorly, or laterally.

By coordinating the two methods outlined the placenta was localized in 97.6 per cent of the cases. Out of 17 cases of placenta previa, the diagnosis was accurately made in 16. It is not intended that roentgenologic procedures should entirely supplant vaginal examinations in suspicious bleeding cases. However, the risk of starting a serious hemorrhage in an undiagnosed case of placenta previa is very great and by detecting these cases roentgenographically, such examinations have been reduced considerably.—*Mary Frances Vastine.*

STEELE, KYLE B., and JAVERT, CARL T. Roentgenography of the obstetric pelvis; combined isometric and stereoscopic technique. *Am. J. Obst. & Gynec.*, April, 1942, *43*, 600–610.

The authors include in their article a summary which is an excellent abstract of the material discussed:

(1) A combined isometric and stereoscopic technique provides for adequate roentgenographic survey of the obstetric pelvis. Both the lateral and frontal films are taken under identical positioning of the patient.

(2) A lateral film containing an isometric scale is employed for measurement of the anteroposterior diameters of the pelvic canal and for the vertical heights of the various planes of the transverse diameters.

(3) A distorted set of scales has been developed for measuring the transverse diameters of the pelvis directly on the frontal film. The planes to be used are obtained directly from the lateral film.

(4) Only two films are essential. However, for complete examination, another frontal stereoscopic film, and a 45 degree film of the pubic arch are recommended.

(5) The precision stereoscope is preferred for study of pelvic architecture and cephalopelvic relationship and labor mechanisms as well as a check on measurements obtained from distorted images with the isometric scales.

(6) Workup of the lateral and frontal films together eliminates the location of uncertain external anatomic landmarks and measurements on the patient.

(7) Introduction of an anterior transverse diameter of the inlet, drawn between the iliopectineal eminences should assist in detecting variations in the forepelvis.

(8) Mensuration of the anteroposterior diameter, the transverse, the anterior transverse, and the posterior sagittal diameter of the inlet provides a basis for classification of pelves.

(9) A common ground has been reached for pelvic classification on the basis of mensuration and morphology.

(10) Cephalometry can be performed. Estimation of the weight of the infant from the size of the head is no longer practiced.—*Mary Frances Vastine.*

TAYLOR, ROBERT. Accessory apparatus to assist in proper posturing of the pelvic inlet. *Am. J. Obst. & Gynec.*, Jan., 1942, *43*, 140–143.

Pelvioroentgenography by the method of Caldwell and Moloy requires that films be taken with the patient supine and with the plane of the pelvic inlet parallel to the plane of the film. These workers advocated the use of a lumbosacral pad to place the pelvic inlet in the proper relation. The author noted that the heavy pad placed under the curve of the lower spine caused a great deal of discomfort to the patient so he devised an angle block with a 20 degree angle slope. The patient rests supine on this block without discomfort with a pillow underneath

the head and shoulders. Diagrams of the block are included in the article as well as roentgenograms obtained with its use.—*Mary Frances Vastine.*

Thoms, Herbert. The clinical application of roentgen pelvimetry and a study of the results in 1,100 white women. *Am. J. Obst. & Gynec.*, Dec., 1941, *42*, 957–975.

The author recommends for routine purposes the taking of two flat films of the pelvis consisting of one view of the pelvic inlet looking down into the pelvic cavity (the inlet view) and the other depicting the lateral aspect of the pelvis. The technique employed in taking these two views is described in detail. Eight diameters which we may consider the cardinal diameters of the pelvis may be measured satisfactorily by roentgen means. These include:

(1) The anteroposterior diameter of the plane of the pelvic inlet.

(2) The transverse diameter of the plane of the pelvic inlet.

(3) The posterior sagittal diameter of the plane of the pelvic inlet.

(4) The anteroposterior diameter of the midpelvic plane.

(5) The transverse diameter of the midpelvic plane.

(6) The posterior sagittal diameter of the midpelvic plane.

(7) The widest diameter of the pelvic outlet.

(8) The pelvic height (or depth) of the outlet.

Pelvic variations as shown by the inlet conformation may be classified as follows:

(1) Dolichopellic or elongated type in which the anteroposterior diameter exceeds the transverse diameter.

(2) Mesatipellic or round type in which the anteroposterior and transverse diameters are of equal length, or the transverse diameter exceeds the anteroposterior diameter by not more than 1 cm.

(3) Brachypellic or oval type in which the transverse diameter exceeds the anteroposterior by more than 1 cm. and less than 3 cm.

(4) Platypellic or flat type in which the transverse diameter exceeds the anteroposterior by 3 cm. or more.

Pelvic inlet studies were made in 1,100 white women and the distribution of the basic types was:

(1) Dolichopellic type—18.6 per cent.

(2) Mesatipellic type—45.9 per cent.

(3) Brachypellic type—32.2 per cent.

(4) Platypellic type—3.2 per cent.

The anteroposterior diameter of the inlet may be used as a criterion for a "small," "average" or "large" pelvis classification as this appears to be the most important single dimension. "Small" pelves in the various types may be designated:

(1) Dolichopellic type, anteroposterior diameter less than 12.0 cm.

(2) Mesatipellic type, anteroposterior diameter less than 11.5 cm.

(3) Brachypellic type, anteroposterior diameter less than 10.5 cm.

Labor was terminated by operative intervention 33 times (6.6 per cent) in a group of 500 patients. When the operations are separated into those which were done because of abnormal pelvic conformation, we find that the most favorable type of pelvis for successful childbearing is one whose inlet is essentially round (mesatipellic) and not the transversely oval pelvis (brachypellic or platypellic).

Studies in women of the college group as contrasted with those of the clinic group make it appear that environment during the growth period is a factor in the lessening of the number of brachy- and platypellic types of pelves found in the former group. It seems probable that, as far as variations of the pelvis are concerned, both nutritional and hormonal influences play major rôles.—*Mary Frances Vastine.*

Brill, Harold M., and Danelius, Gerhard. Roentgen pelvimetric analysis of Walcher's position. *Am. J. Obst. & Gynec.*, Nov. 1941, *42*, 821–835.

The Walcher position of extreme body hyperextension during labor is recommended in leading textbooks of obstetrics as a useful procedure in aiding the entrance of the fetal head into a moderately narrowed pelvis. The authors question: (1) Is the Walcher position of such established efficiency as to warrant its use in spite of the great distress that it causes the laboring woman? (2) If this efficiency is conceded, is the accepted explanation correct, namely, that an increase in the length of the obstetric conjugate is produced?

Twenty patients were studied, 10 in labor and 10 during gestation. Seven of each group were roentgenographed in the comfortable dorsal position, and the remaining 3 in the moderately

flexed position. In each patient comparative measurements were made with the Walcher position. The technique carried out in those roentgenographed in the dorsal position and then in Walcher's position was as follows: The patient was placed horizontally in the dorsal position on a cart in front of an upright Potter-Bucky grid with the pelvis directly over the center of the film. The roentgen-ray beam, leaving the target horizontally, was directed transversely through the pelvis. Following the first exposure, the tube stand and Potter-Bucky grid remained unchanged, while the cart was advanced to a point where its caudal edge was approximately at the vertical center line of the Potter-Bucky grid. The patient was then placed in the Walcher position over the edge of the cart and properly centered for the second exposure. To obtain the actual measurements, a 10 cm. metal ruler was placed lengthwise over the lower abdomen of the patient directly over the midline, carefully avoiding any lateral tilting. The image of the ruler on the film indicated the exact rate of enlargement on each roentgenogram.

In their conclusions, the authors note that: (1) As compared to the comfortable dorsal position, Walcher's position does not increase the length of the obstetric conjugate in a normal profiled pelvis. (2) As compared to the comfortable dorsal position, the exaggerated lithotomy position decreases the length of the obstetric conjugate, in a normal profiled pelvis. (3) The shortening of the obstetric conjugate in the exaggerated lithotomy position led Walcher to the erroneous conclusion that the conjugate is lengthened in the position he advocated. (4) In difficult breech extraction, in a normal profiled sacrum, it is deemed advisable to change from lithotomy to Walcher's position for delivery of the shoulders and aftercoming head because the artificially shortened conjugate will thus recover its loss. (5) In flat sacrum pelves with an anterior sacral prominence, Walcher's position is contraindicated, while lithotomy position will give additional space at the inlet. (6) The two factors of increased muscular tension and altered angle of inclination may explain the reputed clinical efficiency of Walcher's position. (7) Theoretically, a device such as a low abdominal pressure-band and an elevation of the lumbar spine to a moderate lordosis may produce the advantages claimed by Walcher in a manner far less distressing to the patient.—*Mary Frances Vastine.*

D'ESOPO, D. A. The occipitoposterior position; its mechanism and treatment. *Am. J. Obst. & Gynec.*, Dec., 1941, *42*, 937–957.

A large number of pelves with correlated mechanisms of labor have been studied with the aid of the roentgen ray at the Sloane Hospital for Women. From these a random selection of 100 occipitoposteriors that terminated in easy spontaneous or low forceps deliveries and an equal number of midpelvic arrests were chosen for study.

After taking up the etiology of the occipitoposterior position, the author discusses the combined motions of descent, flexion and extension in this position. Following this, there is a consideration of the mechanism of flexion alone and its importance in the mechanism of labor. The phenomenon of rotation is next taken up and carefully discussed from all angles as it applies to the occipitoposterior position.

The considerations in the article which are of roentgenologic interest may be outlined as follows.

(1) The occipitoposterior position is caused, in the main, by adaptation of the head to an inlet possessing a narrow forepelvis and an ample anteroposterior diameter. The pelvic type which comes nearest to these specifications is the anthropoid variety.

(2) In 10 cases in the series the pelvis was so large or the baby so small in relation to the pelvis that the factors which ordinarily make it necessary for adjustment of the head to the optimum inlet diameters did not come into play and the occipitoposterior position could be largely ascribed to a matter of chance.

(3) The more narrow the pelvic brim, the more posterior is the occiput. In the true primary posteriors the occiput is at or behind the sacroiliac synchondrosis and the fetal back practically overlies the mother's spine.

(4) Large babies, small inlets, male characters, as well as the forward sacrum, convergence of the side walls, and narrow arches are distinct factors in the occipitoposterior positions that give difficulty.

(5) Two fundamentally different pelvic forms are frequently associated with posterior positions: (*a*) those in which the transverse diameters are contracted at the brim or midpelvis or at both levels with compensating ampleness in the anteroposterior diameters and (*b*) those in which the anteroposterior diameters are shortened by virtue of a flat posterior segment at the

brim or a forward sacrum at the midpelvis level while the transverse diameters remain ample.

(6) Occipitoposterior positions, although physiologic and in spite of the fact that 70 per cent deliver spontaneously, cause more dystocia than the other vertex positions. Dystocia in posterior positions originates with the abnormality of the pelvis in which they occur.—*Mary Frances Vastine.*

Mayer, Max D., Newman, Herbert, and Ginzler, Arthur M. Simultaneous radiologic and kinetic recording of uterine and tubal motility. *Am. J. Obst. & Gynec.*, Jan., 1942, *43*, 52–58.

A new technique for the simultaneous roentgenologic and kinetic study of uterine and tubal motility is described. Aqueous hippuran is used as the perfusing medium and a constant delivery of the medium is provided by a motor-driven syringe. Continuous pressure records are obtained through a simplified optical manometer incorporated in the system. Serial roentgenograms are synchronized to the inflation apparatus and are taken by means of a continuous strip of radiosensitive paper passed from one lead-lined chamber crossing under a radiotransparent bakelite window into a lead-lined receiving chamber.

The authors' clinical observations were:

(1) In 2 patients, no fluid could be driven past the tubes and in each case rhythmic uterine contractions were recorded while the uterus was being distended with fluid. In each case, the roentgenogram showed the typical funneling at the cornual angle and the apparent block at the beginning or in the first part of the isthmic portion of the tube.

(2) In 1 patient, a pressure tracing with rhythmic pressure waves of a range of 10 mm. Hg was obtained for a few minutes. A roentgenogram obtained while the pressure was rising revealed the left tube filled with medium with the exception of the first centimeter of the isthmic portion. This would suggest a tubal contraction in the isthmus. The waves of pressure then disappeared completely and the plateau level of insufflation pressure fell. A roentgenogram at this time showed that fluid was pouring through a completely filled right tube and the left tube was partially filled in its ampullary portion. This finding tended to support the authors' belief that the usual type of insufflation tracing with small waves of pressure is probably obtained through gas passing through a single tube rather than both tubes.

(3) In 2 patients with single tubes (the other tubes having been removed for ectopic pregnancies), gas insufflation revealed normal tracings. In these cases, rhythmic waves of pressure were observed when the fluid passed through the tubes. In both, the rises of pressure were associated with either completely empty tubes or with the medium only in the ampullary portions.

It is concluded: (1) that the method of investigation described cannot be used if both tubes are patent; (2) in insufflation of gas or fluid in human beings, the fluctuating waves of pressure are probably isthmic in origin.—*Mary Frances Vastine.*

### SKELETAL SYSTEM

Evans, William A., Jr. Recurrent fracture. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 204–219.

Seventeen detailed case reports of recurrent fractures in children are given and the following conclusions are reached:

(1) Fractures are prone to recur when a general or local disease of the bone is present, when healing has occurred with deformity, and at the site of a foreign body.

(2) A fracture may also recur at an old fracture site after healing has apparently been complete and in the absence of a significant deformity or recognizable complicating pathological process. The character of the new fracture indicates an abnormal fragility of bone at the old fracture site.

(3) Recurrent fractures of this type are most often seen in the shafts of the radius and ulna of children. Such children are apt to have poor appetites and to be of less than average weight with thin extremities. The flexible ligaments and blue sclerae which many of them show suggest a constitutional background in common with osteogenesis imperfecta.

(4) It seems desirable for children who have had fractures of the shafts of the radius and ulna to take particular care against a second injury even after the healing of the first injury appears complete and to increase their food intake for the improvement of their nutritional state.—*Mary Frances Vastine.*

McCORD, JAMES R. Osteochondritis in the stillborn. *Am. J. Obst. & Gynec.*, Oct., 1941, *42*, 667–676.

Certain skeletal changes in the fetus and newborn as seen by the roentgenogram are almost pathognomonic of congenital syphilis. McLean and Caffey are quoted when it is noted that these changes include the zigzag or saw-tooth metaphysis.

An analysis of roentgen studies on 129 Negro fetuses at all stages of gestation, the majority of which were stillborn, was made. In the study the diagnosis was made from the roentgenogram without any knowledge of the case and if the roentgenograms showed a positive or doubtful diagnosis, the babies were autopsied. The kidney, liver, spleen, lung, heart and thymus were stained by the Levaditi method and the bone lesions were reported as syphilitic only when the organisms of syphilis were found in the stained tissues. The diagnosis of syphilis as made from the roentgenogram was confirmed by the finding of the organisms of syphilis in 91.5 per cent. Ninety-four per cent of the mothers had positive serology.

The author's conclusions are:

(1) Typical saw-tooth serrations are pathognomonic of congenital syphilis.

(2) Properly done Wassermann and Kahn tests should be positive in probably 90 per cent of the mothers of syphilitic babies.

(3) It can be said, rather arbitrarily, that it is unwise to diagnose congenital syphilis by the roentgen ray in fetuses weighing less than 500 gm.—*Mary Frances Vastine.*

CLEVELAND, MATHER. A critical survey of ten years' experience with fractures of the neck of the femur. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 529–540.

This is a study of 110 fractures of the neck of the femur treated at St. Luke's Hospital over a ten year period. The author's first internal fixation of a fracture of the neck of the femur was performed in 1935. At that time the three flange nail devised by Smith-Petersen was used and since that time no fixative agent to equal it has been found. Stainless steel was the metal originally used but since 1938 vitallium has been used.

The conclusions drawn from this study are summarized as follows:

(1) *Open Reduction and Internal Fixation.* Open reduction and internal fixation of these fractures of the neck of the femur offered very little improvement in end-results over those obtained by nonoperative means.

(2) *Undisplaced Fractures.* The undisplaced fracture of the neck of the femur treated by three to four weeks' rest in bed and weight-bearing after the application of a Thomas caliper brace, gave invariably optimum results. Since the writer's nailing technique has improved, a number of these undisplaced fractures have been nailed without reduction.

(3) *Closed Reduction and Internal Fixation.* The accurate reduction by manipulation and the careful insertion of a three flange nail has yielded surprisingly good results, union of the fracture occurring in 86 per cent of the cases.

(4) *Circulatory Disturbance in the Femoral Head.* Circulatory disturbance in the femoral head, based on experience with 60 patients, has always appeared within the first year after the fracture. Seventy-five per cent of the patients with nonunion of their fractures had extensive circulatory disturbance in the femoral head. Forty-three per cent of those subjected to open reduction had extensive aseptic necrosis. Nineteen per cent of those patients who were treated by closed reduction and nailing showed some evidence of circulatory disturbance, for the most part very mild. The majority of all patients showing circulatory disturbance in the femoral head with fractures united had inadequate reduction of the fracture.

(5) *Adequate Reduction of the Fracture.* Accurate reduction is the most important single factor in securing union and avoiding circulatory disturbance in the femoral head. "Migration" of the nail is usually due to failure to properly reduce the fracture and this migration occurs almost exclusively in ununited fractures.

(6) *Nonunion.* Patients with nonunion may be greatly benefited by a trochanteric osteotomy of the femur.—*Mary Frances Vastine.*

GHORMLEY, RALPH K., POLLOCK, GEORGE A, HALL, BYRON E., and BEIZER, LAWRENCE H. Multiple myeloma. *Surg., Gynec. & Obst.*, Feb., 1942, *74*, 242–244.

In this paper, 41 cases of multiple myeloma are added to the 86 which were reported in a previous communication. This makes a total of 127 patients with multiple myeloma seen at the Mayo Clinic in the sixteen years from January, 1924, to December, 1939.

*Definition.* Multiple myeloma is a highly malignant tumor of the bone marrow.

*Etiology.* Unknown.

*Incidence.* Men are affected about twice as frequently as women. The disease tends to occur after the fifth decade.

*Pathology.* The original description was made by Dalrymple in 1846. Microscopically, the tumors are made up predominantly of cells which closely resemble plasma cells. The myeloid tissue and fat spaces seen in normal marrow are not encountered if a tumor nodule is the source of the material examined. The identity of the cells has not been established. From evidence in recent literature and in the authors' material, it seems likely that in most instances the myeloma cell is derived from reticuloendothelium.

*Symptoms.* There are no symptoms which are pathognomonic of the disease. Backache was the commonest symptom noted in the cases under discussion. Loss of strength and progressive weakness were the complaints which came next in frequency. Anemia, loss of weight, or occurrence of a pathological fracture were described less frequently. The presence of a palpable tumor was rare.

Albuminuria was present in about 70 per cent of the cases and Bence-Jones bodies in 60.7 per cent

*Diagnosis.* Biopsy or sternal aspiration; roentgenological evidence of multiple, punched-out areas of destruction in the skull, ribs, and spinal column.

*Prognosis.* Uniformly poor. The longest duration of the disease in the group under discussion was nine years and two months, and the shortest, four months.—*Mary Frances Vastine.*

Bassler, Anthony. The intestine and chronic arthritis. *Am. J. M. Sc.*, May, 1942, *203*, 698–708.

The authors believe that chronic arthritis is caused by intestinal bacteria that enter the circulation and finally become lodged in cancellous bone or in the periarticular tissues. Streptococci are present in the intestinal tract even in healthy individuals and it is not known why some subjects resist them effectually while about 2 to 3 per cent become victims of chronic arthritis. Probably some of the ill effects are due to symbiosis of other forms of bacteria with the streptococci.

In order to test this theory the author treated 337 cases of chronic arthritis, 205 of them by diet, rectal instillations of colon bacilli which are antagonistic to streptococci and their symbiotic organisms, the oral administration of bacteriophages and in some cases autovaccines.

The diets followed the rule used in chronic biotoxic intestinal conditions. In the putrefactive or alkaline form, diets high in carbohydrates and low in protein were given and in the fermentative or acid form high protein and limited carbohydrates were given.

Among 181 cases 68.5 per cent showed marked improvement with reduction of swelling and increased usefulness of the joints and about 26.5 per cent more were improved to a lesser degree, while in the remainder of the cases there was no improvement. Most of the latter group were old cases in which there was a great deal of deformity.—*Audrey G. Morgan.*

Chasnoff, Julius, Friedfeld, Louis, and Tunick, Arthur M. Hyperparathyroidism in a patient with acromegaly. *Ann. Int. Med.*, Jan., 1942, *16*, 162–175.

A case is described in a woman of sixty-eight who presented the typical pictures of both von Recklinghausen's disease, due to hyperparathyroidism, and acromegaly. Photographs and roentgenograms are given showing these changes.

This patient had had a radical mastectomy in 1924 and in 1928 suffered a blow on the head. A month later she began to have severe parietal headaches and noticed that her hands were becoming large and clumsy and her features coarse.

She was admitted to Beth Israel Hospital in May, 1938, for urinary symptoms, and roentgen examination showed a large calculus almost filling the right kidney and calcareous deposits in the lower pole of the left kidney in addition to the picture of the two bone diseases.

The authors know of no previous case of the coexistence of these two diseases. The possible relationship between hypersecretion of the parathyroids which causes von Recklinghausen's disease and of the pituitary which causes acromegaly, is discussed. It is not known at present whether the patient has hyperplasia or adenoma of the pituitary. Hyperparathyroidism is generally believed to be a primary disease but in acromegaly hyperplasia of many organs, including endocrine glands, may occur. This may

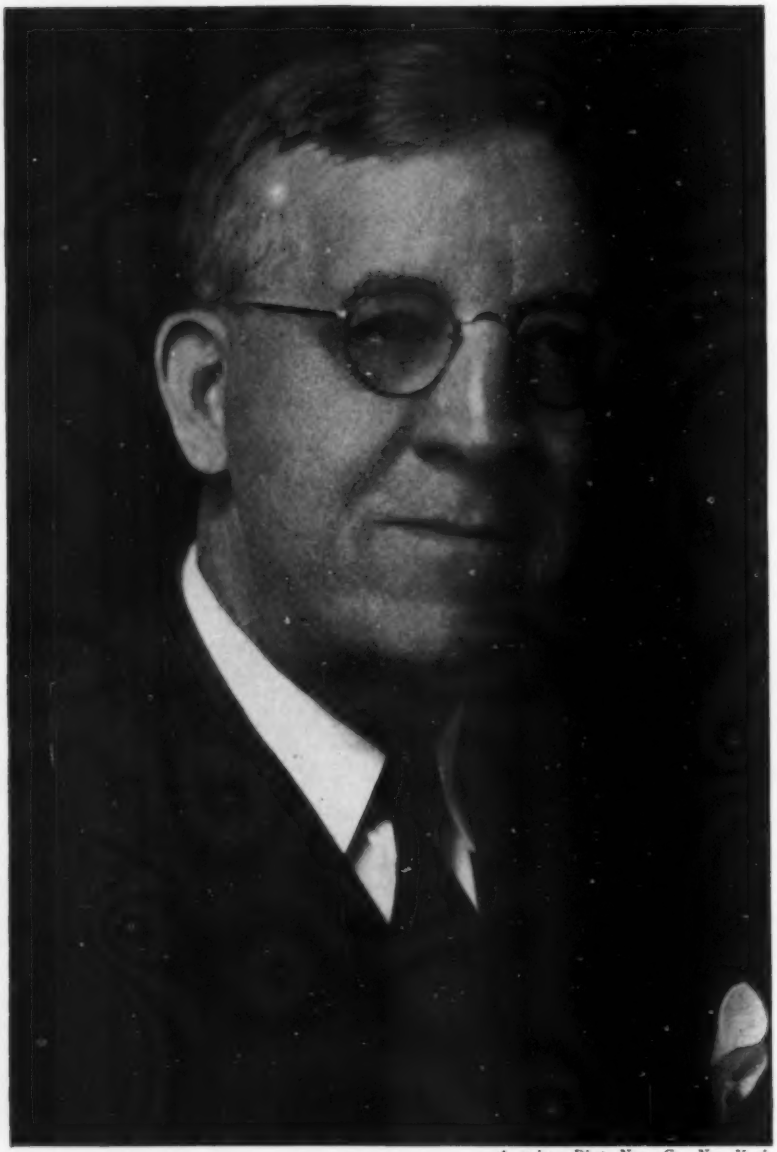
be such a case of hyperparathyroidism secondary to acromegaly or the two diseases may have developed independently of each other.—*Audrey G. Morgan.*

GROSS, PAUL, and JACOX, HAROLD W. Eosinophilic granuloma and certain other reticuloendothelial hyperplasias of bone. *Am. J. M. Sc.*, May, 1942, *203*, 673–686.

A case called eosinophilic granuloma or solitary granuloma of bone was described in 1929 as a separate disease. Up to the present time 16 cases of the disease have been reported, all but three in patients less than twenty-one years of age. These cases have all ended in healing, some with and some without roentgen treatment. The roentgenograms suggest osteomyelitis or tumor. This may result in needless surgery if these cases are not understood. The differential white cell count showed 4 to 11 per cent eosinophils.

The authors believe that this is not a new disease but is a form of reticuloendotheliosis closely related to the other forms of this disease, including Hand-Christian's disease, Letterer-Siwe's disease and solitary xanthoma. They describe one case each of eosinophilic granuloma, Hand-Christian's disease and Letterer-Siwe's disease and give roentgenograms and photomicrographs of the pathological tissue in support of their theory. They maintain that there are no pathologic, roentgen or other signs that can establish a differentiation between these diseases.

Eosinophilic infiltration occurs in all of them. The lesions in Hand-Christian's disease may be solitary and not generalized and it may be that cases of eosinophilic granuloma with multiple lesions will appear. Letterer-Siwe's disease is a non-lipoid reticuloendotheliosis which is generally fatal. Cases have been reported in which there were small amounts of lipoid. There are transition forms between all these reticuloendothelioses and careful autopsy studies should be made of all cases of all of them in order to establish or disprove their identity.—*Audrey G. Morgan.*



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